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The Engineer

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Marine Diesel Engine Working Costs.

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Regulations for Loadlines and Deck Cargoes.

PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES :—

1. AXLES, STEEL, ENGINE.
2. VACUUM BRAKE GEAR.

Tenders due on the 11th September, 1923. Tender forms obtainable from above. 3285

BOILERS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 31st August, 1923, for the SUPPLY and ERECTION of a LANCASHIRE BOILER at the P.O. Telegraph Factory, Birmingham. Forms of Tender, &c., may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Secretary, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 3296

G. R.

LAKEDOWN AERODROME.

Tenders are Invited for the PURCHASE and REMOVAL of HANGARS at the above Aerodrome.

The buildings consist of brick, wood, with corrugated galvanised iron and corrugated asbestos, doors, windows, &c. &c., together with all fittings.

All materials will be required to be removed and the sites reinstated to the satisfaction of the Roads and Communications Officer within 12 months from date of acceptance of contract.

Tender forms and full particulars with permission to view can be obtained from ROADS and COMMUNICATIONS OFFICER, Salisbury.

Tenders should be endorsed "Lakedown" and delivered to

Roads and Communications Office, Evelyn House, Salisbury,

not later than Twelve Noon, 28th August, 1923. 3218

Sale of Pumping Machinery at HELL WATH PUMPING STATION, SOUTH CAMP, RIPON, YORKSHIRE, by PRIVATE TENDER.

This machinery consists of :—

2 National Oil Engines, Nos. 1990 and 1991, horizontal oil engines, water cooled, T.O. type, 25 H.P., 280 revs. per minute, complete with driving pulleys, 40in. by 14in., and blow lamp and spares.

2 Ross Roturbo Pumps, Nos. 4160 and 4161, turbines on centrifugal system, belt driven from engine pulley, head 110ft., revs. 1250, gallons per hour 30,000, complete with bed-plate pedestals, fast and loose pulleys and striking gear.

6 Cooling Tanks, approx. 400 gallons each.

2 Oil Tanks, approx. 400 gallons each.

1 Water Gauge, reading to 60 lb. per sq. in., also test head to 140 lb. per sq. in.

65 Feet Steam Pipe, 4in. diameter.

2 Sluice Valves, 6in.

2 Guards (Wire), 8ft. by 4ft. and 16ft. by 4ft.

2 Priming Cocks, 1in.

32 Feet Chequered W.I. Plates, 15in. wide.

23 Feet Chequered W.I. Plates, 18in. wide.

1 No. 4 Rotary Hand Pump.

1 Receiver fitted with gauge and safety valve for self-starting.

1 Compressor fitted with fast and loose pulley.

30 Feet Steam Pipe, 1in.

The plant can be inspected on site by prior arrangement with Roads and Communications Officer, R.E. Office, North Camp, Ripon.

Tenders, in envelopes endorsed in left-hand top corner "Tenders for Machinery at Ripon," should be addressed to the COMMANDING ROYAL ENGINEER, 19, Wenlock-terrace, York, and should reach that office by Twelve Noon on Monday, 3rd September. 3191

Mechanical Engineer Required by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT, for two tours of 12 to 18 months each, with possible permanency. Salary £600-£50-£720-£40-£800 a year. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave in England on full salary. Candidates, ages 28 to 35, must be highly trained mechanical engineers and have had experience in the repairs of motor cars and vans, in the erection and working of steam machinery, such as woodworking and pumping plant, and general land machinery. They must also have had administrative (including keeping of costs) experience and have had under their control repair and erecting shops.—Apply at once, by letter, stating age and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/11,890. 3325

Ministry of Transport. ROADS DEPARTMENT. APPLICATIONS are INVITED for an APPOINTMENT as RESIDENT ENGINEER for a period of about 18 months for the Construction of a Bridge over the Barking Creek on the East Ham and Barking By-pass Road. Salary £600 to £800 per annum inclusive, according to experience and qualifications. Candidates must have had practical experience in reinforced concrete bridge construction and caisson foundation work. Preference will be given to men who have served in His Majesty's Forces.

Forms of application can be obtained from the ESTABLISHMENT OFFICER, Ministry of Transport, 6, Whitehall-gardens, S.W. 1. Applications can only be received on the recognised forms and should reach the Ministry on or before the 25th August, 1923. 3319

Ministry of Transport. ROADS DEPARTMENT. APPLICATIONS are INVITED for APPOINTMENTS as TEMPORARY INSPECTOR of ROAD SURFACING WORKS in the neighbourhood of London from men with practical experience as supervising foremen in charge of the manufacture and laying of bituminous and asphaltic surfacing material, including clinker bitumen. Wages £5-£6 per week inclusive. Preference will be given to men who have served in His Majesty's Forces.

Applications, giving particulars of age, experience, and qualifications, should be addressed to the ESTABLISHMENT OFFICER, Ministry of Transport, 6, Whitehall-gardens, S.W. 1, and should be received not later than the 24th August, 1923. 3318

PUBLIC NOTICES

The Yarrow Scholarships.

The Council of the Institution of Civil Engineers are prepared to consider APPLICATIONS for NOMINATIONS to the above SCHOLARSHIPS. These should be submitted before the 1st October, 1923, to the SECRETARY of the INSTITUTION, at Great George-street, Westminster, S.W. 1, from whom the detailed regulations may be had on application.

The Yarrow Scholars must be British subjects, who, desiring to become engineers, lack sufficient means to enable them to pursue their practical or scientific training.

The Scholarships are of a value varying from £50-£100 per annum. 3185

UNIVERSITY OF LONDON. King's College.

FACULTY OF ENGINEERING.

COMPLETE COURSES of STUDY, extending over either three or four years, are arranged in

CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING

for the Engineering Degrees of the University of London and for the Diploma and Certificate of the College.

The four years' Course provides, in addition to the academic training, opportunity for practical training in "Works."

HEADS OF DEPARTMENTS.

Professor G. COOK, D.Sc., M.I. Mech. E., A.M. Inst. C.E., Mechanical Engineering.
C. A. GENEVE, B.Sc., A.M.I. Mech. E., Senior Lecturer.
Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering.
C. H. LOBBAN, B.Sc., A.M. Inst. C.E., Senior Lecturer.
Professor E. WILSON, M. Inst. C.E., M.I.E.E. (Dean), Electrical Engineering.
R. E. SHAWCROSS, A.M. Inst. C.E., M.I.E.E., Lecturer.
Professor S. A. F. WHITE, M.A.; Professor G. B. JEFFERY, M.A., D.Sc., Mathematics.

Considerable extensions have been made in the Engineering Department. These include a large additional Drawing-office, Lecture Room, and Laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments; and Research Rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the three Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 3052

University of Birmingham.

DEPARTMENT OF METALLURGY.

Professor: THOMAS TURNER, M.Sc., A.R.S.M., F.I.C.

Lecturers and Demonstrators: T. G. BAMFORD, M.Sc.
HAROLD HARRIS, M.Sc.
T. H. TURNER, M.Sc.

The Course of Study covers three years and leads to the Degree of B.Sc. in Metallurgy. There are separate Courses for Metallurgists and Metallurgical Chemists. Special attention is devoted to Iron and Steel, Copper, Brass, and Local Industries, and to preparation for Colonial and Foreign Posts.

Research and other Scholarships.

For particulars apply to the REGISTRAR. 3184

PUBLIC NOTICES

University College of Swansea (A Constituent College of the University of Wales).

APPLIED SCIENCE DEPARTMENTS.

ENGINEERING.

Professor: FREDERIC BACON, M.A. (Cantab.), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Lecturer in Electrical Engineering: R. G. ISAACS, M.Sc. (Bristol), B.Sc. (Lond.), A.M.I.C.E.
Lecturer in Civil Engineering: H. H. BURNESS, M.C., B.Sc. (St. Andrews), A.M. Inst. C.E., A.M.I. Mech. E.
Assistant Lecturer: J. SELWYN CASWELL.

METALLURGY.

Professor: C. A. EDWARDS, D.Sc. (Manchester).
Lecturer: H. I. COE, M.Sc. (Wales and Birmingham).
Assistant Lecturers: A. L. NORBURY, M.Sc. (Manchester); L. B. PFEIL, B.Sc. (Lond.), A.R.S.M.

The College offers a number of exceptional advantages to Students who aim at entering upon professional careers in Engineering or in Metallurgy. It is situated in the heart of an industrial area, which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The manufacturers of the district, who contribute largely to the support of the College, give the staff and students of the Applied Science Departments every access to the works, and the Managers, Engineers, and Technical Officials co-operate with the staff at the College in making visits to works of practical educational value to the students.

Courses of study are provided: (1) for the B.Sc. Degree of the University of Wales in (A) Civil Engineering; (B) Mechanical Engineering; (C) Electrical Engineering; (D) Metallurgy; and (2) for Diplomas of the College in (A) Civil Engineering; (B) Mechanical Engineering; (C) Electrical Engineering; (D) Metallurgy.

Persons who are not desirous of studying for Degrees or Diploma may attend selected College Classes, provided they satisfy the authorities of the College that they are qualified to benefit by such Classes.

Entrance Scholarships will be offered for competition in September, 1923.

Particulars concerning admission to the College and of the Entrance Scholarships may be obtained from the undersigned.

EDWIN DREW, Registrar.

University College, Singleton Park, Swansea. 3053

University of Manchester. FACULTY OF SCIENCE.

DEPARTMENTS OF CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.

COMPLETE COURSES of STUDY, extending over three years, lead to the University Degree in Civil, Mechanical and Electrical Engineering.

Students who have shown exceptional ability during the first year are admitted to the Honours Courses.

The SESSION COMMENCES on the 4th OCTOBER.

A Prospectus giving full particulars may be obtained on application to the INTERNAL REGISTRAR.

HEADS OF DEPARTMENTS.

Professor A. H. GIBSON, D.Sc., M. Inst. C.E., M.I. Mech. E. (Engineering).
Professor ROBERT BEATTIE, D.Sc., M.I.E.E. (Electrical Engineering).
Professor SYDNEY CHAPMAN, M.A., D.Sc., F.R.S. (Mathematics).
Professor ARTHUR LAPWORTH, D.Sc., LL.D., F.R.S. (Chemistry).
Professor W. L. BRAGG, M.A., F.R.S., Nobel Laureate (Physics).
Professor F. C. THOMPSON, B.Sc., D. Met. (Metallurgy).
Professor O. T. JONES, M.A., D.Sc. (Geology).

Students specialising in Water Supply and Irrigation Work under the direction of Associate Professor SANDEMAN M.Sc., M.I.C.E. 3280

PUBLIC NOTICES

University of Manchester. PHYSICS DEPARTMENT.

Full particulars of the LECTURES and LABORATORY COURSES in PHYSICS, preparing for both the Ordinary and the Honours Degrees, will be forwarded on application to the INTERNAL REGISTRAR.

Professor Bragg will meet intending Students on the 2nd and 3rd October, 10 to 1 and 2 to 4 p.m. 3279

MINING ENGINEERING EXHIBITION.

The South Wales Institute of ENGINEERS, In the DRILL HALL (Dumfries-place), CARDIFF, From NOVEMBER 29 to DECEMBER 8, 1923 (both dates inclusive), Open from 2 p.m. to 8 p.m. each day.

The Council of the South Wales Institute of Engineers invites APPLICATIONS for SPACE in the above Exhibition. The last date for receiving applications is AUGUST 31, 1923.

The Drill Hall has been booked from November 21 to December 14, 1923, so as to allow exhibitors sufficient time for the erection and dismantling of exhibits.

The Exhibition will comprise the following exhibits:

SCHEDULE OF EXHIBITS.

SECTION 1.
Scientific, Measuring and Recording Instruments as applied to all branches of Engineering.

SECTION 2.—STEAM.
Water Softening and Cooling Plant, Boilers and Equipment.
Pipes, Valves, Separators, &c. Drawings or Models of Modern Engines.
Governors and Safety Devices, &c.

SECTION 3.—ELECTRICAL.
Motors of various kinds and Models of Winders.
Switchgear, Cables, Controllers, &c.
Electrical Tools and other Appliances.
Overhead Lines, Small Motors, Electric Cranes.
Telephones and Wireless Apparatus, &c. &c.

SECTION 4.—MECHANICAL.
Mechanical Transmission of Power Above and Below Ground, and Plant and Equipment connected therewith.
Bearings, Clutches, Ropes, Belts, Gearing, &c.
Air Compressing Plant.

SECTION 5.—WORKSHOP APPLIANCES.
Machine Tools (Small), Pneumatic Tools.
Hydraulic Tools, &c. &c.

SECTION 6.—GENERAL.
Shaft Signalling. Devices to Prevent Overwinding.
Models of Pit Cages, Tram Tipplers, and Decking Devices.
Models of Coke Ovens, By-product and Recovery Plant.
Coal-cutting and Conveying Machines.
Models of Screening, Coal Washing and Sorting and Stone Dusting Plant.
Pumping Plant, Couplings, &c. &c.

Exhibits shall be as far as practicable arranged under their various Sections, but exhibitors will be allowed, when exhibiting under more than one Section, to group their exhibits on one stand.

Forms of application for space, ground plan, &c., will be forwarded on application to MARTIN PRICE, Secretary, The South Wales Institute of Engineers, Institute Buildings, Park-place, Cardiff. 2979

Corporation of Chesterfield. WATER DEPARTMENT.

The above Department invite TENDERS for the CONSTRUCTION of a REINFORCED CONCRETE RESERVOIR.

Plans and specification, bill of quantities, and form of Tender may be obtained on deposit of a cheque for £2, which will be returned on receipt of a bona fide Tender and return of documents, on application to the undersigned.

Sealed Tenders, endorsed "Service Reservoir," to be delivered at my office by the first post on 1st September, 1923.

Only those contractors who have had experience for reinforced waterworks need apply.

CHAS. BOLDEY, Engineer.

West Bars, Chesterfield. 3324

County Borough of Tynemouth.

TENDERS are INVITED for the CONSTRUCTION of a ROAD (25ft. wide and about 700 yds. in length) and of SIX BRIDGES, the site of the works being in the vicinity of Northumberland Dock, in the Borough of Tynemouth.

Drawings and specification may be seen at the office of the undersigned, where, upon payment of Two Guinea, two copies of the bills of quantities may be obtained. The Two Guineas will be returned upon a bona fide Tender being received.

Tenders, which must be on forms which will be supplied with copies of the bills of quantities and be enclosed in sealed envelopes, endorsed "Tender to Construct Northumberland Dock Road," are to be delivered at the aforesaid office by, at latest, 10 a.m. on Saturday, the 8th September.

No pledge is given to accept the lowest or any Tender.

JOHN F. SMILLIE, Borough Surveyor.

Tynemouth (Office at North Shields). 3291

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PUBLIC NOTICES

Administrative County of LONDON.

The London County Council invites TENDERS for MECHANICAL STOKERS, COAL ELEVATOR and CONVEYOR for Five Lancashire Boilers for Abbey Mills Pumping Station, Abbey-lane, Stratford, London, E. 15.

Persons desiring to submit Tenders may obtain, on and after Monday, 20th August, 1923, the drawing, specification, form of Tender, &c., on application to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £2. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained upon personal application, and the drawing, specification and other contract documents may be inspected at the Old County Hall before payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 3rd September, 1923, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
3317 Clerk of the London County Council.

County Borough of Halifax.

The Tramways and Electricity Committee of the Halifax Corporation invite TENDERS for the SUPPLY of the following PLANT required in their Electricity Department :—

CONTRACT NO. 50.—ONE 10,000 K.W. TURBO-ALTERNATOR complete with CONDENSER.

Specifications and form of Tender may be obtained on application to Mr. W. M. Rogerson, M.I.E.E., Borough Electrical Engineer, Electricity Offices, 29, Northgate, Halifax.

Tenders, endorsed "Electricity Works, Contract No. 50," must be sent to the undersigned not later than Twelve o'clock Noon on Friday, the 7th day of September, 1923.

The person whose Tender is accepted will be required to observe the Fair Contracts Clauses adopted by the Corporation.

The Committee do not bind themselves to accept the lowest or any Tender.

The placing of the contract will be subject to the consent of the Electricity Commissioners.

By Order,
PERCY SAUNDERS,
Town Clerk.

Town Hall, Halifax,
11th August, 1923. 3295

Metropolitan Water Board.

DISPOSAL OF 2 OLD CORNISH ENGINES AT THE BOARD'S HAMMERSMITH WORKS.

The Metropolitan Water Board invite TENDERS for the PURCHASE and REMOVAL of 2 OLD CORNISH ENGINES, Nos. 3 and 6, situated at the Board's Works, Standish-road, Hammersmith; also for the DISPOSAL of ONE 12 H.P. GAS ENGINE, by Crossley, with fly-wheel 5ft. 6in. diameter by 6½in., and 2 Water Cylinders, Gas Bag, &c., situated at the Board's Works, Roseman-street, Clerkenwell.

The gas engine is in running order and may be inspected on application at the Testing Department, Roseman-street, Clerkenwell, E.C. 1. Either of the above may be inspected at any time between 9 a.m. and 4 p.m. on weekdays (Saturdays excepted) on application.

A schedule containing particulars of the conditions of sale and form of Tender may be obtained from the Chief Engineer, Metropolitan Water Board, 173, Rosebery-avenue, E.C., by personal application (Room 165), or upon forwarding a stamped addressed envelope.

Tenderers should indicate if they require forms for both of the items or one only.

Tenders must be made on the official form, enclosed in sealed envelopes, addressed "The Clerk of the Board, Metropolitan Water Board, 173, Rosebery-avenue, Clerkenwell, E.C. 1," endorsed "Tender for the Disposal of Nos. 3 and 6 Cornish Engines, Hammersmith, and/or 12 H.P. Gas Engine, Roseman-street, Clerkenwell," and must be delivered at the offices of the Board not later than 11 a.m., 3rd September, 1923.

The Board do not bind themselves to accept the highest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board :
173, Rosebery-avenue,
Clerkenwell, E.C. 1,
13th August, 1923. 3300

Metropolitan Water Board.

COVERED SERVICE RESERVOIR AT CHELSFIELD, KENT.

The Metropolitan Water Board invite TENDERS for the CONSTRUCTION of a COVERED SERVICE RESERVOIR of a capacity of about three-quarters of a million gallons at Chelsfield, in the Rural District of Sevenoaks, in the County of Kent.

Drawings, condition of contract and specification may be inspected without payment of a fee at the offices of the Board, Chief Engineer's Department (Room 201), on and after 20th August, 1923.

Forms of Tender, conditions of contract, specification, bills of quantities and schedules of prices, together with drawings and a spare copy of the bills of quantities, may be obtained on and after 27th August, 1923, from Mr. Henry E. Stilgoe, M.Inst.C.E., the Chief Engineer, on production of an official receipt for the sum of £10, which sum must be deposited with the Accountant to the Board and will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawings (with the exception of the spare copy of the bills of quantities, which may be retained by the tenderer).

Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, 173, Rosebery-avenue, London, E.C. 1," and endorsed "Tender for Covered Service Reservoir at Chelsfield," must be delivered at the offices of the Board not later than 10 a.m., Monday, 17th September, 1923.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board :
New River Head,
173, Rosebery-avenue, E.C. 1,
7th August, 1923. 3301

Nottingham Corporation.

NORTH WILFORD POWER STATION.

The Nottingham Corporation invite TENDERS for the MANUFACTURE, DELIVERY, and ERECTION of the undermentioned ENGINEERING WORKS in connection with the above Power Station, viz.:—

SECTION I.—STEAM, WATER and other PIPE WORK, VALVES, TANKS, &c., &c.

Specifications and forms of Tender may be obtained from Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W. 1, on payment of a deposit of £5, which will be refunded on receipt of a bona fide Tender within the prescribed time.

Extra copies of the specifications may be obtained on payment of Ten Shillings for each copy, which will not be returnable.

Sealed Tenders, endorsed "North Wilford Power Station. Tender for Pipe Work, &c.," must be delivered to me at my office not later than 10 a.m. on Friday, the 14th September, 1923.

The lowest or any Tender will not necessarily be accepted, and the Corporation will not consider any Tender which is incomplete or which does not include the whole of the work covered by the specification.

W. J. BOARD,
Town Clerk.

Guildhall, Nottingham,
10th August, 1923. 3265

PUBLIC NOTICES

Romford Rural District Council.

RIVERSIDE SEWERAGE.
COMPLETION OF RAINHAM SECTION.

The above Council are prepared to receive TENDERS for the CONSTRUCTION of 24in., 21in. and 18in. Diameter PIPE SEWERS, including RIVER CROSSING, RAILWAY CROSSING, MANHOLES, FLUSHING TANK, and other incidental Works necessary to complete this section, in the Parishes of Rainham and Hornchurch, Essex.

Drawings, specification and quantities can be inspected at the office of Mr. William Fairley, Consulting Engineer, Parliament Mansions, Victoria-street, Westminster, S.W. 1; also at the office of Mr. W. J. Grant, Surveyor to the Council, 16a, South-street, Romford, from whom a copy of the bill of quantities, inventory of plant and materials on the site, and form of Tender may be obtained on deposit of a crossed cheque for £3 3s., made payable to the Council, which deposit will be returned on receipt of a bona fide Tender.

Sealed Tenders must be delivered to the undersigned on or before Monday, the 3rd September, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

T. W. A. GREENHALGH,
Clerk to the Council.

16a, South-street,
Romford, Essex,
7th August, 1923. 3266

Bombay Port Trust.

ENGINEERING ASSISTANT.

The Trustees of the Port of Bombay REQUIRE the SERVICES of an ENGINEERING ASSISTANT with good experience of Girder, Bridge and Roof Steel Work Design, Building Construction, and Heavy Masonry Work. Should preferably have obtained experience in connection with railway or dock work, and have been some time with a good contractor. Capable of preparing designs and drawings and making calculations under the direct supervision of an Executive Engineer. Salary, Rupees 850 per month, rising annually by Rupees 30 per month to Rupees 940, and, if married, with such married officer's house allowance as he may be eligible for under the rules of the service. Three years' agreement.—Applications, in writing only, stating age, education, technical qualifications, &c., with copies of testimonials, to the CONSULTING ENGINEERS, Bombay Port Trust, 2, Queen Anne's-gate, Westminster, S.W. 1. 3261

SITUATIONS OPEN

WANTED, a CITY ENGINEER, Borough or County Surveyor's fully qualified Assistant Engineer and Draughtsman, with a thorough theoretical and practical knowledge of Building Construction generally, Sanitation, Sewerage, Modern Road Construction and Maintenance, Primary and Secondary School Planning, Land and Quantity Surveying and Estimating generally.

Applications to be addressed to E. BERTEAU, Esq., States Engineer, Jersey (Channel Islands), on or before the 31st inst., stating age, qualifications, experience, and salary required, together with copies of two or more latest testimonials. P7847 A

WANTED by Engineering Firm in the Midlands a live COMMISSION AGENT, having good connection with reliable motor and general engineering firms. Able to secure orders for repetition machine work and machined or unmachined castings in brass, aluminium, cast iron, &c.—Address, giving particulars and state commission required, 3283, The Engineer Office. 3283 A

WANTED by Well-known Firm of Storage Battery Manufacturers, a GENTLEMAN, age about 35, preferably unmarried, to act as CHIEF REPRESENTATIVE in India. Previous experience of Storage Batteries desirable.—Address, giving full particulars, P7857, The Engineer Office. P7857 A

FOR Midlands, AERIAL ROPEWAY ERECTOR. State full particulars, experience, and salary expected.—Address, P7855, The Engineer Office. P7855 A

REQUIRED by English Firm of Engineers in India, an ASSISTANT MECHANICAL ENGINEER. Applicants should have had practical experience in Mechanical Engineering Workshops, also in Drawing office and Estimating Department, and be capable of Preparing Estimates for Foundry, Blacksmiths' and Machine Shop Work. Bachelor required, age 27 to 35.—Apply, giving full particulars, to Z.M. 450, c/o Deacon's, Leadenhall-street, E.C. 3. 3315 A

THE BRITISH REINFORCED CONCRETE ENGINEERING CO., Ltd., 1, Dickinson-street, Manchester, REQUIRE the SERVICES of a High-class SALESMAN with a knowledge of Reinforced Concrete Construction or Constructional Engineering, to Represent them in Lancashire and Cheshire. The districts will be worked from Liverpool office. Travelling experience will carry preference. Replies, marked "Confidential," should state age, qualifications, and salary required. 3306 A

WANTED, DRAUGHTSMAN, with Shop Training and sound General Mechanical Experience, for temporary engagement of at least 12 months if satisfactory. Age preferably from 28 to 40.

Apply, giving full particulars and salary required, to the CITY ELECTRICAL ENGINEER, 24, Hatton-garden, Liverpool. 3299 A

WANTED, DRAUGHTSMAN, with Practical Knowledge of Uniflow and Extraction Engines. Address, stating experience and salary expected, P7866, The Engineer Office. P7866 A

WANTED for DRAUGHTSMAN'S OFFICE, YOUNG LADY, experienced in Engineers' Tracings and Blue Printing. State salary, age, and experience. Walthamstow district.—Address, 3321, The Engineer Office. 3321 A

WANTED in South of England, DRAUGHTSMAN for General Engineering. State age, experience, and salary required.—Address, 3316, The Engineer Office. 3316 A

DRAUGHTSMAN, First-class, WANTED; Capable of Designing Gasworks Plant, particularly Gas holders, Purifiers, Condensers, &c. None but efficient men having the necessary qualifications need apply.—ASHMORE, BENSON, PEASE and CO., Ltd., Stockton-on-Tees. 3320 A

DRAUGHTSMEN, Junior and Senior, WANTED for Steam Turbines, Details and Power Station Layouts; also for heavy Oil Engines.—Application, by letter only, giving full experience, age, and salary required, to CHIEF DRAUGHTSMAN, The English Electric Co., Ltd., Willans Works, Rugby. 3296 A

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For continuation of Small Advertisements see page 3

A Seven-Day Journal

Shipbuilding at Belfast.

The tonnage launched at Belfast during the first six months of the year included seven vessels, having an aggregate of 90,000 tons, or 3000 tons in excess of the whole output from the port in 1922. The increase is largely accounted for by the Minnewaska, for the Atlantic Transport Line, and the Majola and Mooltan, for the P. and O. Line, each of which exceeded 20,000 tons. All these ships were built at the Harland and Wolff yards, as was the oil tanker Inveravon. At the yards of Workman, Clark and Co., Limited, the Holt liner Dardanus, the Head liner Torr Head, and the collier Berwendmoor were completed. The outlook at present is not so bright and shows a decline in tonnage, although there are now ten vessels on the stocks, four being fitted out and three repair jobs. On Saturday last Lord Pirrie, in a letter addressed to the Belfast District Committee of the Engineering and Shipbuilding Trades Federation, refusing an advance in wages, pointed out the difficulty of securing new contracts even at the bare cost of materials and wages, plus only a portion of the establishment charges. If, under present conditions advances were conceded, such a course, he says, could only lead to, further suspensions of work and an increase in unemployment. Lord Pirrie stated that he was doing everything in his power to help the situation, and he would like to assure the members of the trades belonging to the Federation that were it not for the present reduced costs, there would not be the amount of work in the port which to-day it is fortunate in possessing.

Diesel Engines in France.

It is announced that the French Ministry of Public Instruction has decided to institute special courses of study with a view to training specialists in the working and use of Diesel engines and hot-bulb motors. Courses of instruction are to be given in the technical schools, and they will deal with both the practical and theoretical sides of the subject. As far as possible the needs of the various parts of the country will be considered, and special attention given to the application of such motors for marine purposes. A particular course of instruction is to be held in Paris for engineers and manufacturers who wish advanced information on the subject. According to a recent estimate there are over four million horse-power of Diesel engines in use, of which France possesses the modest share of some 150,000 horse-power, most of which is represented by land engines. The Government recognises the apathy which exists with regard to Diesel engines, and regards the situation as one largely caused by the majority of the French nation being unaware of the qualities and possibilities of the heavy oil motor. It is hoped that the courses provided by the Ministry of Instruction will create a body of engineers and mechanics familiar with oil engine practice and ready to further the use of such plant in motor ships and in industry generally.

The Cruise of the New Brighton Lifeboat.

On Monday morning last the new 60ft. "Barnett" type lifeboat, designed by the Royal National Lifeboat Institution for its New Brighton station, left Cowes for a cruise around the coasts of Great Britain. During the next two months the boat will visit the chief coast towns and seaside resorts, giving an opportunity for the general public to inspect her before she takes up her work on the Mersey about September 25th. The programme of visits carried out this week embraced the towns on the South and East Coasts, and to-morrow, Saturday, the 18th instant, the boat leaves Yarmouth for Hull and the North-East Coast, and Scotland, Wales, and Ireland are included in the remaining programme of visits. In many respects the New Brighton lifeboat is a notable ship. The two six-cylinder 90 horse-power engines designed by the Institution give her a speed of 9 to 10 knots and a radius of action of 100 miles—or 150 miles at cruising speed—as against the 50 miles radius of the largest of her predecessors. Other improvements are the arrangement of water-tight compartments and air buoyancy cases and the provision of cabin space for fifty people. In all there is accommodation for 150 people in the boat. All these qualities fit her for Mersey service, where she will take the place of the present steam lifeboat, the Queen.

A Trade Union Alliance.

An important scheme, which in London alone affects over 100,000 workers, will be discussed at a joint conference of the Transport and General Workers' Union and the National Union of Railwaymen, which is called for August 18th. The scheme concerns an agreement which has been reached between the two unions for co-operative action in defence of their interests. At the conference named proposals will be submitted for the formation of joint committees and the setting up of the necessary machinery for the carrying out of the agreement throughout the country. A manifesto, which is to be issued jointly by the two unions, states, we understand, that both the Executive Committees have reached a complete understanding and that they are determined to free this section of the transport industry from non-unionism. The alliance has been described as a counter move to the unity of the employers as shown in the Federation of British Industries. In this connection it is of interest to note that the National Sailors and Firemen's Union have passed a resolution expressing a desire to affiliate with the Transport and General Workers' Union.

Marine Aircraft for Cross-Channel Work.

A little over a year ago we referred in these columns to the new cross-Channel air service between Southampton, the Channel Islands and Cherbourg. Further details are now forthcoming with regard to this new air line, which will, we understand, be operated by the British Marine Air Navigation Company. It is stated that the Air Ministry has promised a subsidy of £10,000 annually and a guarantee of 50 per cent. of the cost of the aircraft up to £21,000. The company guarantees a minimum of 60,000 miles per annum and the agreement is limited to one year. The starting station will be at the aerodrome at Woolston, Southampton, and the landing stations at Guernsey and Jersey are to be just outside the harbours. Negotiations are proceeding with the French authorities at Cherbourg with a view to connecting with the Atlantic services from that port. The type of machine to be used is the Supermarine Sea Eagle, which recently took part in the King's Cup race round Britain. Two machines will be used at first, each carrying six passengers besides the pilot, and the journey will probably be made in an hour and a-quarter or an hour and a-half. In a fortnight's time a newspaper-carrying service will be started, which, it is hoped, will be speedily followed by a passenger service.

A Trade Mission to Russia.

An important trade mission, representing the interests of about eighty British engineering firms, arrived in Moscow early in the week. The visit has been arranged by Becos Traders, Limited, formerly the British Engineering Company, of Russia and Siberia, Limited, which concern had, at the time of the revolution, many branches in different parts of the old Russian Empire. The negotiations with the Soviet authorities have been successfully concluded by the managing director of the company, Mr. A. G. Marshall, and it is hoped that a foundation for future business will be arranged. The leader of the deputation is Mr. F. L. Baldwin, the chairman of Becos Traders, Limited, and also a director of Archibald Kenrick and Sons, Limited, of West Bromwich. Other members of the party include Sir Chas. Wright, of Baldwins, Limited; Mr. John Denny, of William Denny and Bros., Limited; Mr. J. J. Carter, of Crossley Bros., Limited; and Major Barley, representing Nobel Industries, Limited. Mr. N. Neville, Mr. S. W. Reeve and Mr. J. Wardroper, all of Becos Traders, Limited, are also taking part in the visit. The step which has been taken would seem to be an important one, especially in view of the present disturbed industrial conditions in most of the countries of Central Europe.

The Channel Tunnel.

A memorandum recently issued by Sir Percy C. Tempest deals with the various aspects of the Channel Tunnel project and the means whereby the scheme can be carried through. He reiterates the assertion that the undertaking is perfectly practicable and one which can be carried through without meeting any difficulties other than those which can be surmounted by present-day methods. It is estimated that the total cost of constructing the tunnel at present-day prices would be about £29,000,000, and as regards revenue, figures relating to the existing cross-Channel traffic show a possible net revenue of £1,595,000, or 5 per cent. on the capital outlay. The cost of the tunnel is, of course, intimately connected with the method of constructing it, and to furnish reliable figures in this respect a special boring machine has been constructed and tested by the Channel Tunnel Company, Limited. The trials which have been made show that a heading, 12ft. in diameter, can be bored in the chalk marl at the rate of 120ft. per day, which, allowing for contingencies, corresponds closely to a rate of progress of about one mile in ten weeks. Assuming two machines were used and the boring of the shafts took, say, six months, the headings driven from either side would meet each other in about three years from the time the work was begun.

London Underground Station Improvements.

Some measure of the increased traffic on the underground railways of the Metropolis may be gained from the returns of passengers using any given station. In the year 1907, when the Piccadilly Circus Station was first opened, one and a half million persons made use of it, and in 1922, for the same period of one complete year, this number had risen to 18 million passengers. The station is now to be rebuilt in order to accommodate the volume of traffic, and it will take the form of an oval constructed some 15ft. beneath the Circus. In the new station the lift service will be superseded by six escalators, three of which will serve the Piccadilly Tube and three the Bakerloo Tube. An interesting feature of this arrangement will be that the centre escalator of each group will be made reversible, so that at the busy periods the direction of movement may be altered to suit traffic requirements. Other amenities will include wide circulating areas, improved facilities for boarding the trains, while fifteen passimeters will simplify the obtaining of tickets. Another station at which considerable improvements are being made is Westminster, which it is expected will be completed about the end of September. The new approaches and booking hall, with its system of passimeters, will increase the capacity of the station nearly 50 per cent.

The Broadcasting Inquiry.

It was anticipated that the Committee appointed by the Government to inquire and report on broadcasting in all its aspects would be in a position to present its report early in the present month. We now learn, however, that it has been necessary to make further inquiries into certain financial questions affecting the broadcasting problem, and that in consequence the Committee will be unable to make its report as early as had been expected.

A New French Cruiser.

On Tuesday last the French light cruiser, the Duguay-Trouin, was launched at Brest by M. Raiberti, the Minister of Marine. The ship was built in a period of one year and ten days—her keel was laid on August 4th, 1922—and this constitutes, so it is stated, a record for French naval construction. The main dimensions of the cruiser are:—Length between perpendiculars, 575ft.; breadth, 57ft. 4in.; and draught, 17ft. 4in.; with a displacement of about 8000 tons. Four shaft geared turbine machinery is fitted, designed to develop about 9600 shaft horse-power, giving a speed of 34 knots. Oil-fired boilers are installed. Her armament includes eight 6.1in. guns, four 75 mm. anti-aircraft guns, and twelve torpedo tubes of 21.5in. in diameter. Each cruiser of this class will carry two scout seaplanes, which will be launched from the ship by means of catapults. The Duguay-Trouin is the first of the three cruisers provided for in the naval programme, and the Primauguet will take her place on the slipway at Brest. The third ship, the Lamotte Picquet, is being constructed at Lorient.

Exhibition of Patents.

There was opened yesterday in the offices of the Institute of Patentees at 44, Great Russell-street—opposite the entrance to the British Museum—an exhibition of inventions, and considering the space available, it is representative of a very wide field of ingenuity. There are models of all kinds of devices, from wireless apparatus to burglar alarms, lifts, safety locks for doors, and shock absorbers for motor cars; but what struck us more forcibly than anything else was the way in which the exhibition demonstrated the hopeless futility of many inventions. How, for instance, can anyone imagine that an apparatus for serving hot plates of soup by means of centrifugal action has any practical value. If the exhibition only brings home to the inventors of such ideas the absolute waste of time and energy which they involve, it will have done good work. We do not, of course, wish to suggest that all the exhibits are of this class, as many of them are distinctly ingenious and offer prospect of commercial utility. In the majority of cases it is not possible for the inventors to be present to explain their ideas, but the officials of the Institute do all they can to demonstrate the models.

Railway Statistics.

The recently published Ministry of Transport railway statistics for February are of special interest as, for the first time, figures with respect to the operation of 124 marshalling yards are given. The total number of passengers—excluding season ticket holders—was 87,461,389, a decrease of 110,413, or 0.13 per cent., compared with February, 1922; while the corresponding receipts showed a decrease of £514,663, or 12.39 per cent. The passenger train-miles run were 833,724 more than in February, 1922, an increase of 4.79 per cent. The average length of haul for all goods traffic—except free-hauled—fell from 56¼ miles to 52¼ miles. The goods train receipts—less cost of collection and delivery—in February, 1923, were £9,183,317, showing a decrease of £470,152, or 4.87 per cent., compared with February, 1922. Altogether the goods train-miles run were 904,498 more than in February, 1922, or an increase of 8.84 per cent., and the average train load increased from 133 tons to 135 tons, but owing to a decline in the rate of movement the net ton-miles per engine hour fell from 454.88 to 453.86.

Electricity in Mines.

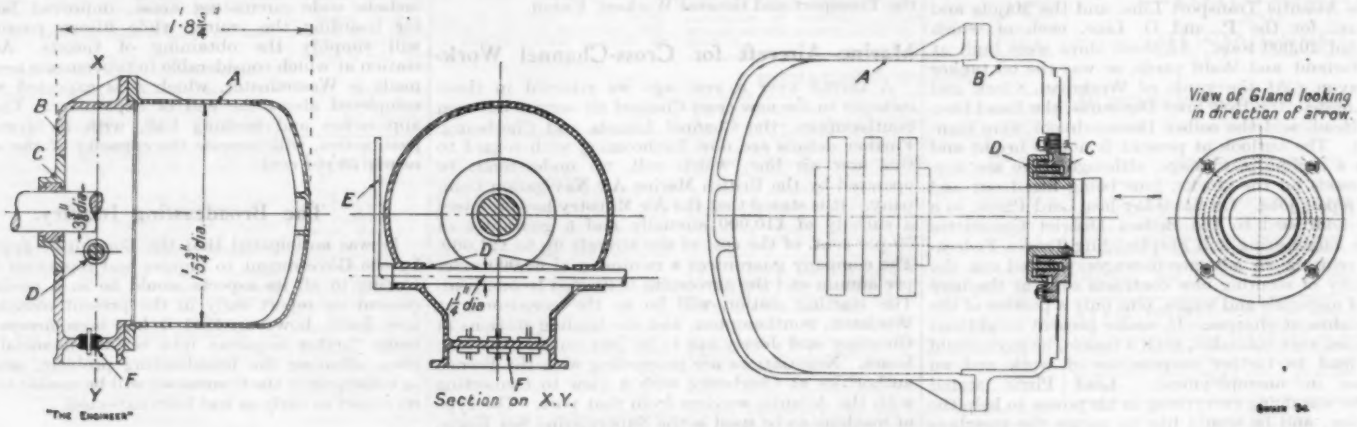
No. IV.*

THE 1911 Coal Mines Act specifies, in Sec. 60, that electricity shall not be used in any part of a mine where, on account of the risk of explosion of gas or coal dust, the use of electricity would be dangerous to life. It is also specified that if at any time the percentage of inflammable gas in the general body of the air in any place in the mine is found to exceed one and a-quarter, the electric current shall at once be cut off from all cables and other electrical apparatus in that place, and shall not be switched on again as long as the percentage of inflammable gas exceeds that amount. Sec. 86 of the same Act states that the Secretary of State may, by order, make general regulations for the conduct and guidance of the persons acting in the management of mines or employed in or about mines in order to prevent dangerous accidents, and to provide for the safety, health, convenience and proper discipline of the persons employed in or about mines. Under Sec. 86 general regulations as to the installation and use of electricity have been made and issued, with an explanatory memorandum in Mines and Quarries Form No. 11, the latest edition being dated April, 1921. Regulation 132 provides that for use in any part of a mine in which inflammable gas is likely to occur in quantities sufficient to be indicative of danger, all motors must be constructed so that when any part is alive, all rubbing contacts, such as commutators and slip rings, are arranged or enclosed so as to prevent open sparking—*i.e.*, sparking which, owing to the lack of adequate provisions for preventing the ignition of inflammable gas, external to the apparatus, would ignite the inflammable gas. The explanatory memorandum states that this regulation does not insist on the complete enclosure of motors, and that in general there is no constructional difficulty in arranging for the separate enclosure of the slip rings of an alternating current motor. It is pointed out, however, that covers composed of thin sheet metal or light castings are useless as a protective enclosure because of the high internal pressure that is liable to be developed, and that the enclosure may be made useless by lack of adequate attention to the method of attaching the cables.

With these requirements in view the Metropolitan Vickers Electrical Company has developed two kinds of slip-ring covers, which have been subjected to many thorough tests to prove their ability to withstand high internal pressure, and to ascertain whether internal explosions would ignite a surrounding inflammable mixture. As a result of these tests two types of slip-ring covers have been standardised—(*a*) A wiper brush type for motors up to about 200 horse-power; and (*b*) labyrinth gland type cover for motors over about 200 horse-power. While explosions may occur where air is charged with finely divided coal dust or other combustible material, the most dangerous cause of mine explosions is the presence of the gas methane, which is also known as fire-damp and marsh gas. Two of the Metropolitan-Vickers Electrical Company's engineers, viz., Messrs. R. W. Bailey and A. M. Roberts, have shown that when the most violently explosive mixture of air and methane is exploded from atmospheric pressure within a single closed chamber, the maximum pressure theoretically obtainable cannot exceed 125 lb. per sq. in. In practice the pressure obtainable is very much below that value, because of the loss of heat given up during combustion to the metal walls of the cast iron containing cover, and to the slip rings and shaft. As a result of this loss of heat, the maximum pressure that could be obtained within the slip-ring covers during tests made at the works of the above company did not exceed 60 lb. per square inch.

The wiper type of cover is shown in Fig. 25, which gives two sectional views of a slip-ring cover designed to include brush-lifting and short-circuiting gear. A cast iron cover A is bolted to a casing B, and there is a spigot and socket machined joint. The casing is bolted to the bearing housing of the motor, and carries a wiper gland, as shown at C. The brush is lined with a white metal bearing which fits closely round the shaft. Brush lifting and short-circuiting gear is operated by the handle E and the spindle D, which passes through long bearings in the supporting casing. Cables are brought into this casing either through closely-fitting insulating brushes or through sealing boxes fitted with armour-clamping glands. Three distinct kinds of tests were made on this type of cover. In the first case the cover A was submitted separately to an internal pressure of 160 lb. per square inch, and subsequently the cover A and supporting casing were assembled and submitted to an explosion test with the wiper bearing blanked off. Both these tests proved satisfactory, and the wiper bearing was then placed in position. A series of explosion tests was then made with a dummy shaft in the bearing and without slip rings, the clearance in the wiper bearing being greater than that adopted in practice. The maximum pressure obtained was 60 lb. per square inch, and no ignition of the surrounding explosive mixture occurred. To ascertain the effect of excessive wear in the wiper brush tests were made with an exaggerated clearance, which amounted to 0.040in., this clearance being greater than that of the wear that is permissible in bearings of motors up to 200 horse-power, for it is to be remembered that small air gaps are necessary in alternating-current motors up to that capacity. An interesting fact brought to light by these tests was that with appreciable clearance between the white metal brush and shaft, an automatic sealing action takes place. As the gust of hot gas passes into the gap between the shaft and brush it heats the white metal at the inlet edge of the brush to its melting point and carries the melted metal forward into the cooler part of the brush, where it solidifies in the form of a ridge. In this way the passage becomes choked, and the hot gas is effectively cooled and is rendered incapable of igniting any surrounding mixture.

The wiper brush gland has been adopted as standard for use in motors up to about 200 horse-power capacity. Beyond that capacity the area of clearance round shafts of increasing diameter becomes larger, thus causing a reduction in the allowable safety margin. Further, in the larger size motors, the use of a larger air gap allows a greater margin for wear of the bearings before adjustment becomes necessary. For these reasons a special patented labyrinth type of gland has been developed for use with motors exceeding 150 or 200 horse-power. The point of change-over from one type of motor to the other depends upon the speed of the machine. The labyrinth gland is shown in Fig. 26. A cast iron cover A is bolted to a fixed casing B, and there is a spigot and socket joint between them. The casing B is bolted to the



FIGS. 25 AND 26—EXPLOSION-PROOF COVERS FOR SLIP-RING MOTORS

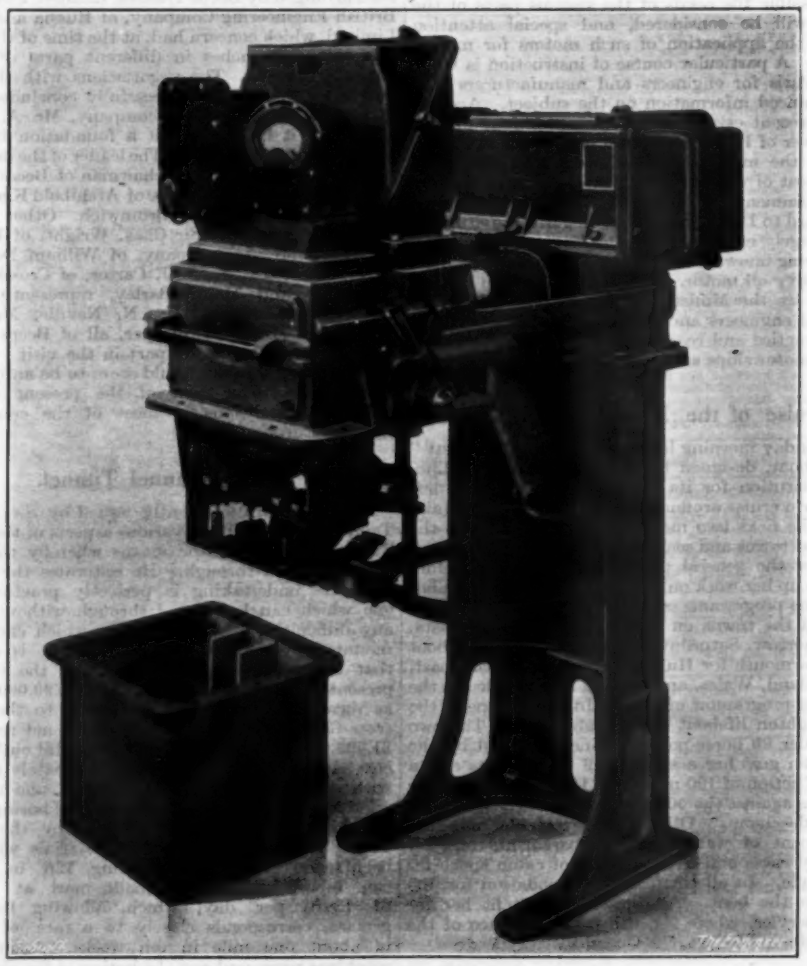


FIG. 27—SWITCH FITTED WITH EXPLOSION-PROOF RELAY

* No. III. appeared Aug. 10th.

bearing housing of the motor, and carries the fixed portion of the labyrinth gland marked C. The revolving part of the gland D is secured to the shaft, the running clearance between the two portions being not less than 0.05in. Tests made on this type of gland were, in all respects, similar to those made on the wiper bush gland cover, and included an internal hydraulic pressure test of the cover A, an explosion test on the castings A and B with the gland blanked off and a series of explosion tests of the cover with the labyrinth gland in position. Further explosion tests were made with first one, and then both flanges cut off the revolving portion D, but in neither case did ignition of the surrounding mixture take place.

It is gratifying to find that, during the inquiries into recent coal mine accidents, no mention was made of electricity in connection with the most serious accidents. This seems to indicate that the large amount of research work that has been carried out has led to good results, but this does not imply that electrical engineers should relax their efforts. A. Reyrolle and Co., Limited, of Hebburn-on-Tyne, have done much in the direction of improving mining switchgear. The explosion-proof relay shown in Fig. 27 constitutes one of the firm's most notable developments. The standard core balance relay has been re-designed to comply with the 1911 Coal Mines Act respecting flame-proof apparatus. The risk of open sparking has been entirely removed. The relay has 1in. flanges on the case and its cover, and a machined face is also provided for attaching the instrument to the switch hood. The ordinary inspection window has been replaced by a reinforced glass window, which is fixed in a circular gland with cement. The handle of the re-setting device is enclosed in a screwed brass cap, which is attached by a screw to the cover, and this cap fulfils three purposes. It prevents the re-setting device becoming choked with coal dust; it removes the possibility of accidental operation; it preserves the flame-proof qualities of the gear, and if it is desired to operate the relay by hand the cap is easily removed. The possibilities of open sparking occurring have been surveyed from all angles, and the makers claim to have surmounted the problem of the capacity spark on the withdrawal of the switch by the use of an ingenious device.

Further improvements have also been made by the company in the development of flame-proof circuit breakers of 10-ampère and 20-ampère capacity. The flanges are of the flame-proof type; the design is simple, and the number of parts has been reduced to a minimum. The interlocking system is designed so that the switch cannot be operated unless the cover is bolted down, and the cover cannot be removed unless the switch is in the "off" position. Among the many developments that have taken place in Reyrolle plugs and sockets the most prominent is a 60-ampère mining plug, in which an extra pin is provided for the earth connection, and the pin makes contact before the current-carrying pins, and breaks the circuit after the latter, thus complying with the Home Office regulations. Besides other special switchgear, the firm has devised a reliable motor starter for underground use. This starter—see Fig. 28—has a double-pole circuit breaker, which is interlocked with the starting rheostat, and the circuit is fully protected by a no-volt and an adjustable overload release. A magnetic blow-out is fitted on the first contact, and the operation of pushing a button stops the motor instantaneously. As shown, the case of the starter has wide machined faces, and the starter is built to comply in every way with the usual flame-proof specification.

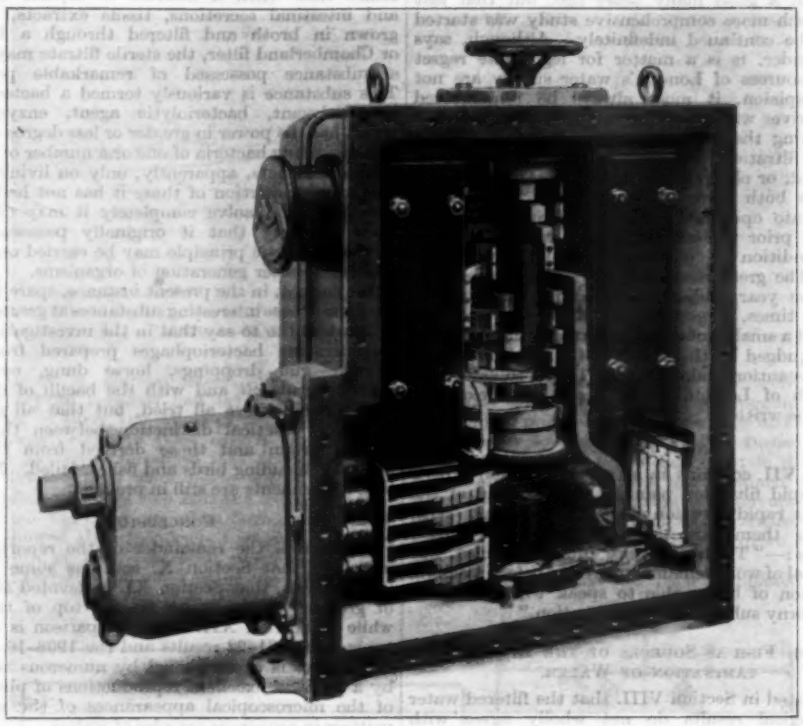


FIG. 28—MINING MOTOR STARTER

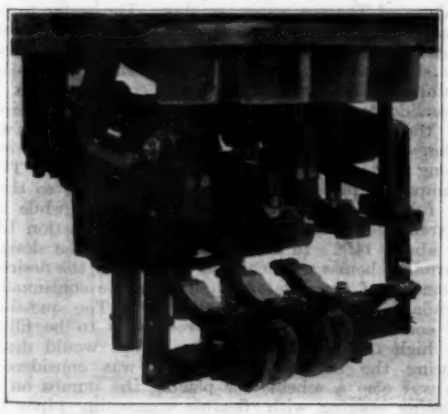


FIG. 29—SWITCH FOR MINING WORK

Switches drawn from the company's stores have been operated in a very explosive mixture of gas and air, so as to comply with the test devised by the Home Office authorities, and the results of these tests have shown that the gear conforms with the stringent Home Office regulations. Tests have also shown that the actual breaking capacity of the company's switches is well above the rated breaking capacity. The switch shown in Fig. 29 broke four times its rated current without any damage to the sparking contacts, save a slight pitting.

Report on London Water Supply.

THE seventeenth annual report on the waters composing the supply of London, made by Sir Alexander C. Houston, the Director of Water Examination to the Metropolitan Water Board, has recently been published. It certainly does not fall behind in interest those which have gone before it, for it is brim full of valuable data and information. So full is it, in fact, that it will be quite impossible for us to do more than touch upon the leading features of its contents.

As an introduction to his subject, Sir Alexander gives some telling figures with the object of enabling his readers to form some sort of a conception of the magnitude of London's water undertaking. Water is supplied to nearly 7,000,000 persons inhabiting over 537 square miles. In round figures the average daily supply is 250 million gallons, about 60 per cent. being derived from the river Thames, 20 per cent. from the river Lee, and 20 per cent. from deep wells. Two hundred and seventy-four engines of an aggregate of 43,417 horse-power are required for the collection and distribution through 6577 miles of pipes of this vast quantity of water. The total volume of well water pumped—41.8 million gallons daily—is not all supplied direct to consumers. About 9½ million gallons are pumped into the river Lee or the New River, and, mixed with the river water, are afterwards filtered. The 32.3 million gallons per day supplied direct to consumers would be sufficient to provide the total population of a large city such as Birmingham with 35 gallons per head. The proportion obtained from the New River would, similarly, supply such large cities as Liverpool or Manchester with 35 gallons per head. The same daily quantity *per capita* could be provided for the combined populations of Sheffield and Bristol by the volume taken from the river Lee. These figures are, however, all put in the shade by the statement that the water taken from the Thames—150 million gallons per day—would suffice to give to each of the inhabitants of Glasgow, Liverpool, Manchester, Birmingham, Sheffield and Bradford, taken together, 35 gallons. The amount of Thames water which is chlorinated—70 to 80 million gallons per day—would suffice, at 35 gallons per head per day, for the supply, *conjointly*, of such large towns as Glasgow, Edinburgh, Dublin and Belfast.

Chlorination of Thames Water.

Sir Alexander divides his report into twelve sections. The first deals with the chlorination of Thames water. It is explained that it had previously been the custom to abstract from 70 to 80 million gallons per day of raw Thames water and to allow it to flow down the Staines Aqueduct. At the Staines pumping station the water was pumped from the aqueduct into the Staines reservoirs, and after passing through them it was again allowed to enter the aqueduct down which it flowed to supply the Sunbury, Kempton Park, Grand Junction (Hampton and Kew) and West Middlesex (by pumping) Works. The cost of pumping this large volume of water into the reservoir was very considerable, and as a war measure, to save fuel, the experiment was made in 1916 of chlorinating the water with a view to seeing if by that means the raw river water could be rendered as pure as, or purer than, would be the case had it been stored in the reservoirs for the requisite period. As our readers are aware, the experiment was an outstanding success, and ever since it was first made, between 70 and 80 million gallons of water per day have been treated—saving for short periods of flood—and no less than 2,000,000 persons have been supplied with chlorinated water for some seven years now without one single complaint as regards taste. The chlorinating medium employed is "bleach," and the average dose in terms of available chlorine is 1 in 2.45 millions. The financial result of working during the year covered by the report was a saving of some £16,050, as compared with what would have been the cost had pumping been necessary.

Chlorination of the New River Water.

The second section of the report is concerned with the New River supply. The New River is really part of the water of the Upper Lee, diverted along an artificial channel—nearly 30 miles long, constructed by Sir Hugh Myddleton three hundred years ago or so—the point of diversion being above where the Hertford Sewage Works now are. Apart from accidental contamination, the New River is free from pollutions during its whole course, and in quality it at all times compares very favourably with either the Thames or the Lee. A certain proportion of deep well water is pumped into the channel and allowed to mingle with the river water. There are reservoirs at Hornsey and Stoke Newington through which the water is allowed to flow, but they are not of large capacity being, according to Sir Alexander, "quite inadequate in size to meet modern requirements as regards the exclusion, or purification, of flood water, and the growing demands for water." Moreover, the filtration area is far from generous in the light of present needs, and though, during nine months in the year, the water as it was delivered to consumers was of great purity, during the remaining months—normally November, December and January—"floods produced a remarkable transformation in results." With no adequate reserve of storage the intake could not be closed when the river Lee was in high flood, and that, combined with the relatively high rates of filtration, led to water being supplied in an unsatisfactory condition. This was so in spite of the fact that as much flood water as possible was excluded, and an attempt made to supply the deficiency by pumping more and more well water into the channel.

By treating the water with chlorine during flood times this condition of affairs has been vastly improved. "Floods have largely ceased to raise apprehensions, the effects of winter have been, so to speak, 'wiped out,' and the safety of consumers has been ensured, humanly speaking, throughout the entire year, without loss of potability, and at a working cost which can only be described as trivial." Actually, some 3,348,000,000 gallons of water were treated during the period covered by the report at a nominal cost of £245, which represents not quite 1s. 6d. per million gallons. In point of fact, as is pointed out,

there was, in addition, a great saving involved, since the interest on the capital expenditure which would have had to be incurred in providing remedial works to render the New River water pure during floods, would have far exceeded the small sum required for chlorination.

Deptford (Twins) Well Chlorination Treatment.

Speaking generally, the water from the Board's deep wells in Kent are of outstanding purity, both chemically and bacteriologically. In Section III. of the report, however, it is pointed out that in 1921 typical *B. coli* was found in 100 c.cm. of the water from what is known as the Deptford (Twins) Well, and it was decided to install a chlorine plant until the source of the trouble could be traced. Actually, the source has not yet been discovered, and the treatment of the water was continued as a precautionary measure until quite recently—in fact, till after the report was written—when it was discontinued because the well water had recovered its original state of great bacteriological purity. During the time that the treatment was being employed, a great many laboratory experiments were carried out to avoid, if possible, taste troubles. Apparently, with a dose of about 1 in 4 millions, no chlorinous, or iodoform, taste could be detected, but if the dose were increased or decreased materially, the effect was to impart to the treated water either a chlorinous or an iodoform taste, respectively. Even with a dose of 1 in 4 millions, although no taste could be detected at, or near, the point at which the treatment was effected, there arose occasional waves of taste in the area of supply and not always at the same places. There seemed to be some evidence that the treated well water acquired a taste after mixing with untreated water; but, as Sir Alexander remarks, "the whole thing was baffling in its obscurity." At length the determination was come to to super-chlorinate by means of a dose of 1 in 1 million, and then to de-chlorinate by a solution of sulphurous acid gas. The treatment had been in progress since February 4th, 1922, till the date of the report, and not a single complaint as to taste had been received except on the few occasions when there was a temporary breakdown in the de-chlorinating plant, which has now been installed in duplicate.

In this connection, Sir Alexander remarks: "An iodoform taste once produced can never be got rid of by de-chlorination, but a chlorinous taste is instantly removed by this method. Moreover, a super-dose of chlorine will prevent the formation of an iodoform taste, so that the method adopted at Deptford ensured a water free from both the chlorinous and the iodoform taste and a bacteriologically perfect water supply."

Suspended Solids in Thames River Water.

Section IV. of the report contains a table showing the quantity and composition of the suspended solids in Thames river water at set intervals throughout the year, together with simultaneous readings of the flow of water in the river, the average natural flow, and the rainfall. Since November, 1920, the suspended solids have been determined gravimetrically. Interesting examples are given to show how the amount of solids vary at different times of the year and under different conditions. For the weeks ended September 3rd, 1922, and January 7th, 1923, the weight in pounds per million gallons of suspended matters were 27 and 629 respectively. The remarkably different effect which rain produces according to the season of the year is well exemplified by taking the four weeks ended July 23rd, 1922, and comparing them with the four weeks ended January 4th, 1923. The rainfall during the first period was 4.8in., yet the average flow of the river was only 622 million gallons per day, and the suspended solids 64 lb. per million gallons. During the second period the rainfall was 4.79in.—practically the same as in the first period—but the flow as high as 2886 million gallons, and the suspended solids were as high as 440 lb. per million gallons.

"Resistance to Filtration" Experiments.

The "resistance to filtration" investigations, which were instituted a number of years ago, and which we described fully at the time, have been continued with satisfactory results. All the pre-filtration waters, and the raw waters as well, are tested for "resistance to filtration," by which is meant the degree to which the suspended matters—living and dead—in a water interfere with its filtration by blocking the filtering material. The nature and amount of suspended matters in the pre-filtration waters are, observes Sir Alexander, of great interest and practical importance. Many of them are living and some give rise to taste troubles, while all of them exercise a greater or less influence on the task of filtration. It is comparatively easy in the laboratory by appropriate filtration experiments, combined with microscopical examination, to foretell what is likely, or certain, to take place when a pre-filtration water is subjected to sand filtration at the Board's works. It is true, continues Sir Alexander, that it is not always deemed desirable to treat—*e.g.*, with copper sulphate—a water showing the early signs of becoming badly affected and thus averting filtration troubles, but an early intimation to the Engineering Department that things are not altogether satisfactory may allow of certain measures being taken in advance, so as to minimise, as far as possible, the trouble caused by the subsequent choking of the filters. Sometimes the choice between using two different waters for filtration purposes arises, and in such cases the laboratory "findings" can usually be fully trusted to decide the issue. It is curious to note in what different ways stored waters behave as regards filtration. Thus, with tap water giving a figure of 289, Staines (North) stored water is represented by 259, and West Middlesex No. 6 reservoir stored water only 116, all figures being the average of all observations during twelve months.

Pre-Filtration Waters.

In Section VI. it is explained that the systematic examination of all the waters—over twenty in number—began a good many years ago, but that last year a much more comprehensive study was started and will be continued indefinitely. Although, says Sir Alexander, it is a matter for legitimate regret that the sources of London's water supply are not above suspicion, it must always be remembered that *raw* river water—saving in the case of the New River during the major part of the year—is never used for filtration purposes. Either the water is chlorinated, or else it is stored for many weeks, and sometimes both these processes of purification are brought into operation. The net result is that all the water prior to sand filtration has been brought into a condition of considerable, if not remarkable, purity. The great mass of pre-filtration water was, during the year under consideration, improved at least ten times, a goodly proportion one hundred times, and a small amount of it actually one thousand times, as judged by the *B. coli* test. "A finer eulogy of the precautions taken by the Board to safeguard the health of London could," says Sir Alexander, "hardly be written."

Rapid Filters.

Section VII. contains an account of a small experimental rapid filtration plant at Staines, and of the permanent rapid filtration plant at Barn Elms. With regard to them Sir Alexander expresses himself as follows:—"The results are full of promise, but a great deal of work remains to be done before reaching the position of being able to speak with assurance on the thorny subject of rapid filtration."

Gulls and Fish as Sources of the B. coli Contamination of Water.

It is stated in Section VIII. that the filtered water bacteriological results do not wholly agree with what might have been anticipated from a consideration of the quality of the water antecedent to filtration. As an example it is said that the West Middlesex filtered water results have not infrequently presented certain puzzling features, especially as regards *B. coli*. The explanation given is interesting. Although, it is explained, fish may play a part in the *B. coli* contamination of water, it is chiefly the gulls which visit the Board's works in great numbers during the winter that are to blame. The matter was specially investigated in connection with the West Middlesex works, as the gulls seem to have a special predilection for that spot. Flying up the Thames estuary, they appear to regard it as a haven of rest, and, as there are plenty of fish, they doubtless find it an excellent feeding ground. As each gramme—about 15 grains—of their "droppings" may contain a million typical *B. coli*, it is obvious that their presence is the reverse of welcome. At the same time Sir Alexander desires to make it quite clear that he does not regard the matter seriously from a health point of view. There is, in his opinion, a wide distinction between the intestinal discharges of man and those of birds and the lower animals. At the same time, as it is at present impossible to distinguish between the fæcal bacteria of gulls and those derived from human beings, the presence of the former renders it extremely difficult to interpret correctly the significance of the bacterial results. For example, when *B. coli* are detected in West Middlesex water during the winter it is impossible to tell whether their presence is produced by gulls' excreta, in which case their significance is slight, or comes from human and, therefore, potentially dangerous sources. It appears most improbable, having regard to the level of the water, that the water in the West Middlesex reservoirs can be contaminated by human agency. They are, for the greater part of the year, charged with chlorinated water, and Sir Alexander's experience is to the effect that the chlorine treatment is not to be regarded as a temporary "dope" which which only sends the *B. coli* to sleep for a period, so to speak, so that they can again come to life. It is, therefore, most probable that the presence of *B. coli* in such numbers in those particular reservoirs is due entirely to the presence of the gulls. Nevertheless, many patient attempts were made to ascertain whether or not it were possible to differentiate between human *B. coli* and those emanating from other sources. Among the efforts made in this direction were those embodying the use of bacteriophages.

Bacteriophages.

What bacteriophages are and how they were employed in these investigations are set out in Section IX. "Bacteriophages," says the report, "are mysterious substances of recent discovery which have the amazing power, even in high dilutions, of dissolving certain bacteria. Some regard them as ferments and others as possessed of living properties—certainly they are the most intriguing substances that have attracted the attention of bacteriologists for many years." It has always been a matter of regret to bacteriologists that they could not distinguish satisfactorily, if at all, between the *B. coli* of human origin and the *B. coli* derived from birds, fishes and the lower animals. It was hoped that bacteriophages might furnish a solution to the problem, but, unfortunately, so far success has not been achieved.

As to what bacteriophages actually are, Sir Alexander states that within recent years it has been found that when a mixture of certain organisms and intestinal secretions, tissue extracts, &c., are grown in broth and filtered through a Berkefeld or Chamberland filter, the sterile filtrate may contain a substance possessed of remarkable properties. This substance is variously termed a bacteriophage, bacteriolysant, bacteriolytic agent, enzyme, &c., and it has the power in greater or less degree of killing and dissolving bacteria of one or a number of different species. It acts, apparently, only on living bacilli,* and on a proportion of those it has not had time to destroy and dissolve completely it may confer the same property that it originally possessed itself, so that the lytic principle may be carried on through generation after generation of organisms.

We cannot, in the present instance, spare the space to discuss these interesting substances at greater length. It must suffice to say that in the investigation under consideration bacteriophages prepared from crude sewage, gull droppings, horse dung, cow dung, human fæcal *coli*, and with the bacilli of dysentery and typhoid, were all tried, but that all efforts to obtain a practical distinction between the *coli* of human origin and those derived from the lower animals, including birds and fishes, failed. Nevertheless, experiments are still in progress.

Conclusion.

As regards the remainder of the report, we can only say that Section X. contains some meteorological notes, that Section XI. is devoted to a study of growths in the water on the top of the filters, while in Section XII. some comparison is made between the 1921–22 results and the 1906–16 averages. The report is accompanied by numerous tables and by a series of excellent reproductions of photographs of the microscopical appearances of the suspended matters in numerous samples of waters.

Plant for Purifying Tidal River Water.

The rapid filtration plant which has been recently put into service at the Beckton Works of the Gas Light and Coke Company, Limited, and which forms the subject of to-day's Supplement, is, without doubt, one of the largest installations yet put down for the purpose of purifying tidal river water for general industrial use. It was designed and constructed by the United Water Softeners, Limited, of Imperial House, Kingsway, London, W.C. 2, and has a capacity large enough to deal with 4,000,000 gallons of Thames water per day. The water to be treated and filtered is raised from the river by centrifugal pumps driven by vertical spindle electric motors. As shown in the accompanying plan—Fig. 1—the pumps are arranged beneath the company's No. 2 riverside coaling jetty, and the water is delivered to the main filter and pump-house through two 12in. diameter cast iron mains, which are carried along the underside of the pier structure. The pumps are placed at nearly half-tide level, so that at full tide they are entirely submerged, while at extreme low tide there is a maximum suction lift of about 14ft. In the initial stages of the design various schemes were considered whereby the desired quantity of river water might be made continually available at all states of the tide. The question of constructing impounding reservoirs to be filled at high tide, from which the pumps would draw during the between-tide period, was considered, as was also a scheme for placing the pumps on a floating staging with flexible connecting pipes to land. Pumps fixed below the pier were, however, finally adopted on the ground of lower first cost, greater simplicity and reliability in working.

The general appearance of the reinforced concrete building in which the pumping machinery is housed will be seen by the upper views of the Supplement, while the general relation of this building to the jetty, the river, and the sub-station from which power supply is taken, is indicated in the drawing, Fig. 1.

Foundations and Reinforced Concrete Construction.

The actual work of preparing the foundations and carrying out the reinforced concrete constructional work was placed in the hands of Industrial

* Fleming's recently discovered lysozymes are an exception to this statement.

Constructions, Limited, 44, Grosvenor-place, S.W. 1, and operations were begun early in November, 1920. One of the most important considerations in preparing the design of the building was the question of the foundations. As completed, the building illustrated in the accompanying engravings—Figs. 2, 3 and 6—covers an area of close upon 11,000 square feet, and a total weight of 5945 tons had to be supported on a site consisting of ground made up for a depth of, approximately, 30ft. After the merits of several schemes had been considered, it was decided to carry the whole of the load on pre-cast reinforced concrete piles driven through the filling and old river foreshore into the underlying ballast. Trials which were made with three preliminary piles, two of which had the usual cast iron shoes and one the point cut off to form a 6in. square shoe, all showed that the desired set was obtained after a depth of 38ft. had been reached, and this length was, therefore, adopted as the standard.

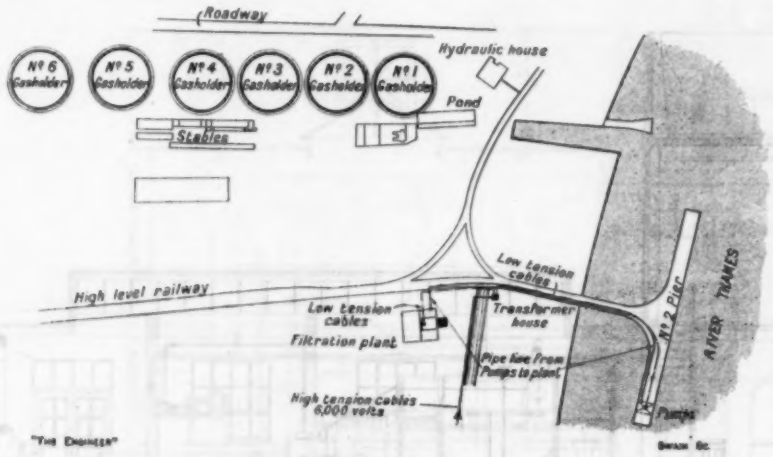


FIG. 1—PLAN SHOWING POSITION OF FILTER PLANT

The 1in. bars being bent down and tied with $^{5}/_{16}$in. diameter binders along with $^{3}/_{16}$in. diameter diagonal ties. The foot thus formed tapered in the concrete from 14in. to 6in. square in a length of 9in. Concrete consisting of 4 cubic feet of crushed gravel to 2 cubic feet of washed sand to 1¼ cubic feet, or half a bag of Portland cement—eleven bags to the ton—was used for casting the piles, which were made horizontally, and the bars were covered to a depth of 1in. Three pieces of Simplex tube were cast into each pile to provide holes for dragging, pitching and guiding purposes. After the piles had been made for three or four weeks they were turned so as to release the bottom shuttering and pile driving was begun after the first piles had attained an age of seven weeks and proceeded uninterruptedly. As each pile had to be driven to its entire length of nearly 38ft., it was not possible to drive more than five per day of eight hours.

When the driving had been completed and the setting out checked, it was found that no single pile had deviated from its true position more than ½in. in any direction, so that no alteration was required for the shuttering of the pile caps and link beams, which had been prepared beforehand. The heads of the piles were then stripped and the pile caps and link beams cast *in situ*. Illustrations of this work and the reinforcement used are given in our Supplement. On account of the porous nature of the ground and the structural importance of the beams running between the piles, it was decided to form the shuttering to all members in the ground in coke breeze concrete, except in such places as where, owing to the absence of a floor slab, the timber shuttering could be allowed to remain in position. This procedure added to the cost of the foundation work, which amounted to nearly 25 per cent. of that of the reinforced concrete superstructure, but it resulted in all the beams cast in the ground being made to the exact dimensions shown on the drawings. Timber had, of course, to be used while casting the coke breeze shuttering, but only enough for half the job was made, and it was afterwards removed and transferred to the other half.

The whole of the superstructure illustrated by the drawings reproduced in Figs. 2, 3 and 6 was built in reinforced concrete. The concrete used throughout the whole of the superstructure was machine mixed in the proportion of 4½ cubic feet of crushed gravel to 2½ cubic feet of washed sand to 1¼ cubic feet, or half a bag, of Portland cement. Finely ground cement of British manufacture was used, and the reinforcement consisted of smooth bars throughout.

No waterproofing compound was used, and the walls, which we inspected shortly after testing and again after the plant was in operation, proved to be perfectly water-tight. The water-tightness of the structure was undoubtedly assisted by all the necessary piping and castings being built into the concrete as the work proceeded.

The Filtering Plant.

The filtering plant, designed and constructed by United Water Softeners, Limited, comprises eight filters with two pairs of adjoining settling basins for coagulation and sedimentation. The filters are divided into two groups of four on either side of the pump house. The settling basins for each of the four filters are provided with sluice-gate arrangements, so that if necessary one pair of basins may be laid off and cleaned while the other pair is in operation. To the rear of the pump house, on a level above the basins, is placed the chemical house which accommodates the lime-mixing tanks and the measuring and recording apparatus. A view of this part of the building is shown in the Supplement, while the

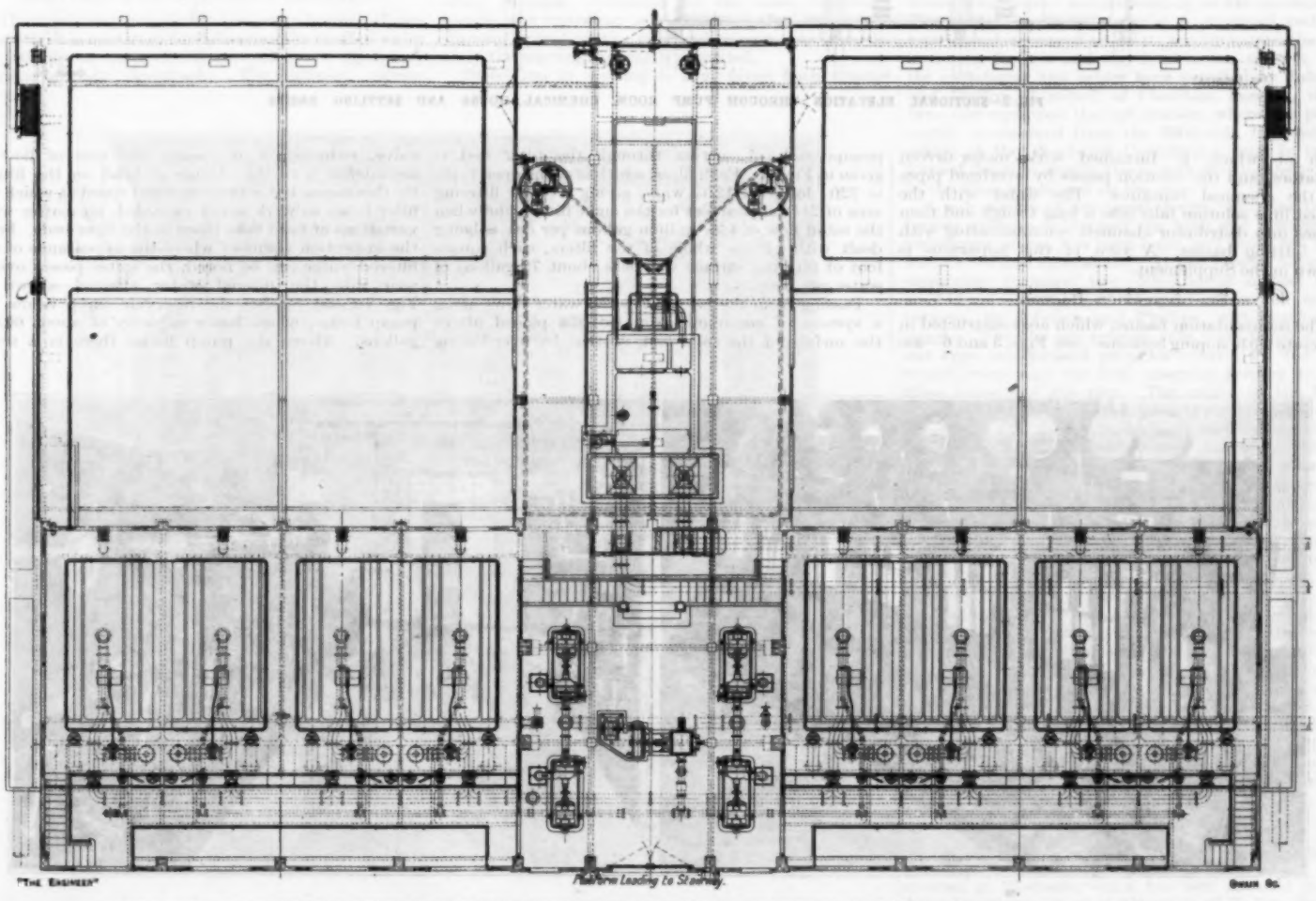


FIG. 3—PLAN OF PUMP ROOM AND CHEMICAL HOUSE, WITH FILTERS AND SETTLING BASINS

In all 124 piles were made, and of these 114 were 14in. square, and the remaining ten 16in. square. The reinforcing bars for the 14in. piles comprised four steel bars 1in. in diameter with $^{5}/_{16}$in. diameter steel binders top and bottom varying from 2in. to 6in. centres, while between these were ¼in. diameter steel binders placed at 6in. centres. Four pairs of straining forks for keeping the main bars apart were used on each pile. No pile shoes were employed,

elevation and plan are seen in the drawings reproduced in Figs. 2 and 3 respectively.

The water delivered from the river by the pumps on the pier is received into a concrete chamber furnished with baffles, whence it is delivered into a measuring channel, and then flows over two brass plate weirs of rectangular form and one larger than the other. The exact quantity of water passing over the larger weir at any time is measured and

recorded on an integrating Rheograph. A definite portion of the incoming water passes by means of the smaller weir into an automatic measuring apparatus of the Lassen and Hjört type, which is fitted with a chemical container and a chemical mixing valve so adjusted as to deliver the exact quantity of lime necessary to coagulate and precipitate the suspended and silicious matter contained in Thames water at Beckton.

The lime solution is prepared in two mixing tanks, each of which is furnished with motor-driven agitators, and the solution passes by overhead pipes to the chemical container. The water with the added lime solution falls into a long trough and then passes into distributor channels communicating with the settling basins. A view of this apparatus is shown in the Supplement.

Sedimentation Basins.

The sedimentation basins, which are constructed in concrete with sloping bottoms—see Figs. 3 and 6—are of sufficient size to hold approximately 600,000 gallons of water, thus allowing a period of nearly four hours for reaction and sedimentation, when the plant is working at its full rated output of 4,000,000 gallons of purified water per day. For cleaning out the basins sluice valves and drain sewers are provided at both sides of the building—see Fig. 2—but it has been found in practice that thorough cleaning is only needed at periods of about ten to twelve weeks.

The water enters the first settling basin at the back, and after passing down beneath a baffling wall, it takes an upward course and, moving in the direction of the filter beds, overflows the sill of the first and passes forward to the second compartment, in which, after again being deflected beneath a baffle, it rises to the surface and is decanted over a trough—see Fig. 6—leading to the filter inlets. During its passage through the basins, the heavier impurities and a considerable portion of the coagulated flocculent are precipitated. A section through the filter bed is given in Fig. 6. Each filter, which is of the open type, is 22ft. long by 12ft. wide, giving a total filtering area of 2112 square feet for the eight filters, and when the rated flow of four million gallons per day is being dealt with by the whole of the filters, each square foot of filtering surface will pass about 79 gallons of water per hour.

Passing from the inlet valve the water flows along a system of communicating troughs placed above the surface of the sand bed, so that by overflowing the edges of these troughs, the incoming water is distributed over the entire upper surface of the filter. The filtering medium employed is specially sifted and graded quartz sand supported on a bed of washed and graded gravel. Below the gravel there is a system of manifold collecting tubes furnished with safety strainers, by which the water is simultaneously drawn off from all parts of the filter bed. The water thus collected is discharged through a central pipe and passes through a ball control valve to the automatic rate of flow controller. The ball valve operates the filter outlet and ensures that water is always retained in the filter bed to a certain level. It also retards the outflow after cleaning, so that time for filming is given before the full discharge takes place. The rate-of-flow controller is situated in an outer inspection chamber. It consists essentially of a floating piston attached to a moving throttle diaphragm, which opens or closes the outlet of the valve, reducing or increasing the rate of flow in accordance with the change of head on the filters. By this means the maximum rated speed at which the filter is set to work is not exceeded, no matter what variations of head take place in the filter bed. From the inspection chamber where the appearance of the filtered water can be noted, the water passes over a weir into the filtered water channel—shown in Fig. 7—and reaches the reservoir sump below the pump house, which has a capacity of about 60,000 gallons. Above the pump house there is a tower having a capacity of 40,000 gallons, in which filtered water for cleaning the filter beds is stored. The sump reservoir and the wash water tower are illustrated in Fig. 3.

Before describing the pumping plant reference may be made to the method of cleaning the filter beds. The operation is performed by agitating the filtering medium with compressed air at a pressure of 3 lb. to 5 lb. per square inch for a period of about 2 minutes.

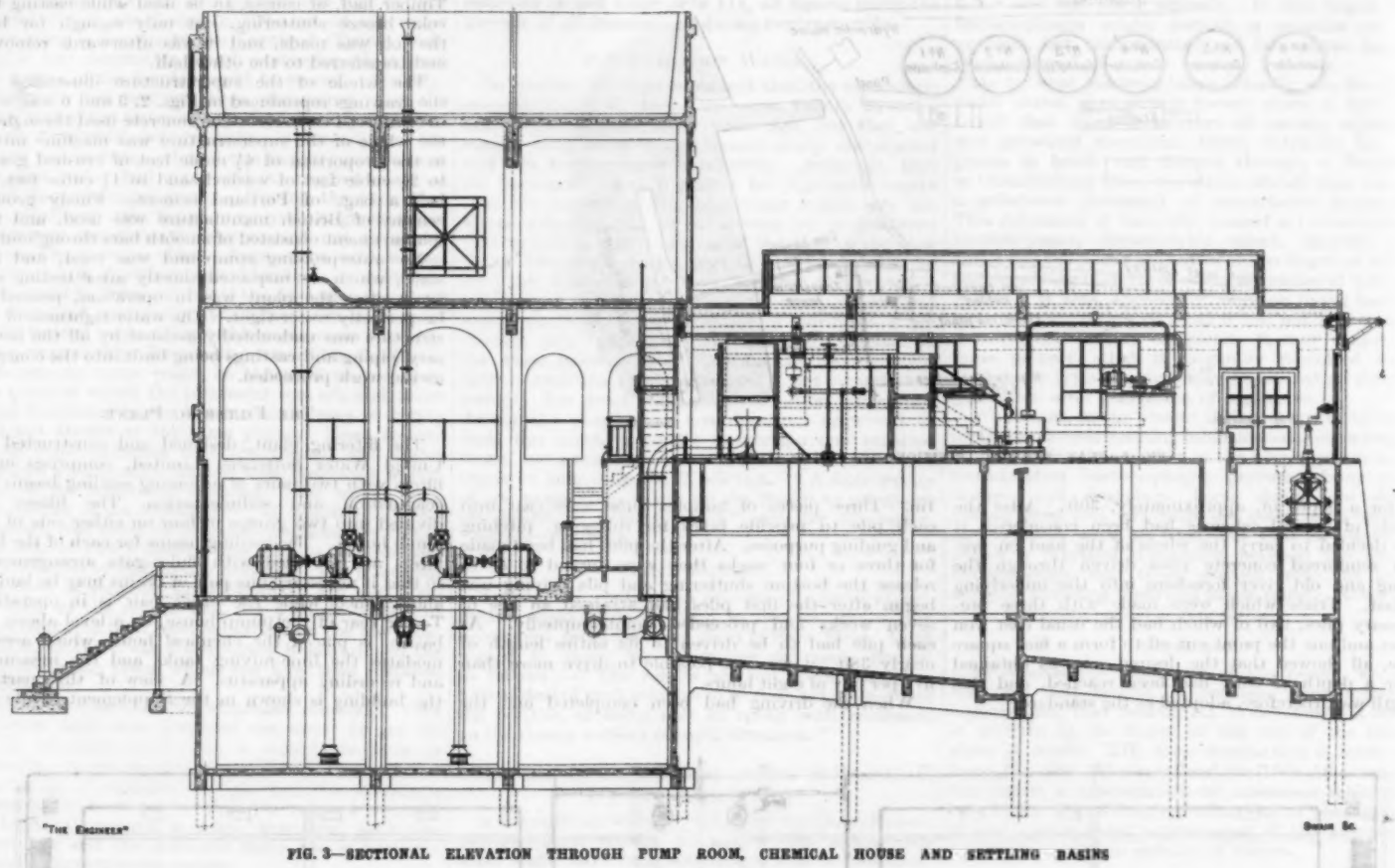


FIG. 3—SECTIONAL ELEVATION THROUGH PUMP ROOM, CHEMICAL HOUSE AND SETTLING BASINS

FIG. 4—PEDESTAL TYPE SWITCHES IN THE PIER PUMP HOUSE

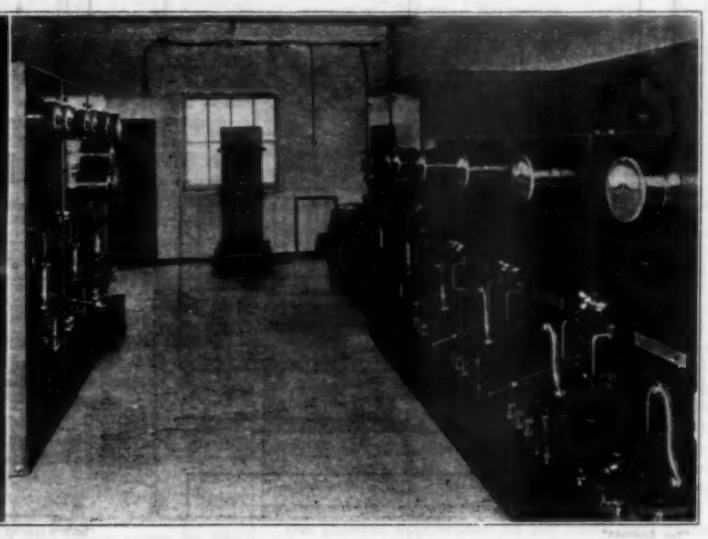


FIG. 5—INTERIOR OF SUB-STATION SHOWING SWITCHGEAR

A reverse current of cleansing water is then applied to the underside of the filter bed, and in its passage upwards through the bed, the impurities deposited on the sand are floated over into the connecting waste troughs and pass out through a waste pipe to the drain channel.

We have seen some of the filters thoroughly cleaned and restarted to work within the space of ten to twelve minutes. The compressed air is supplied by a rotary blower made by Bryan Donkin and Co., Limited, Chesterfield. A view of the blower is given in the lower right-hand view of the Supplement, and it is driven through gearing by a 28 brake horse-power Macfarlane three-phase motor.

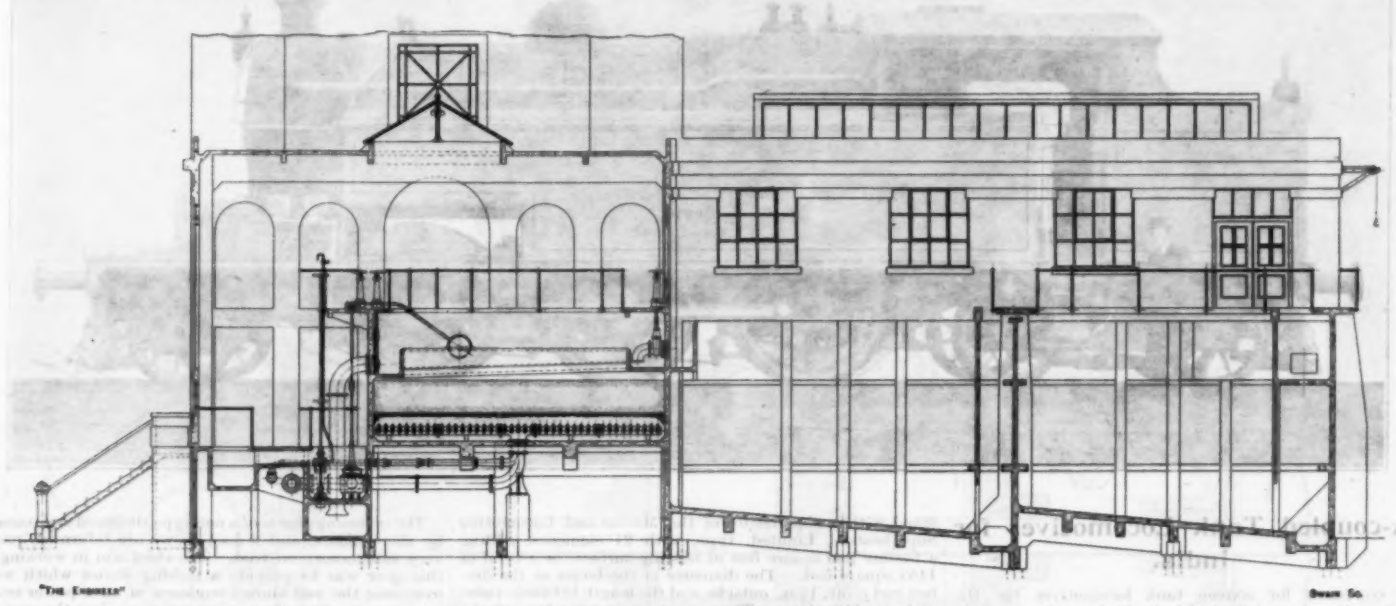


FIG. 6—VERTICAL SECTION THROUGH FILTER BED AND SETTLING BASINS

The Pumping and Electrical Equipment.

The machinery installed in the pump house includes that which is necessary for delivering the treated water to the various parts of the gasworks, and the rotary blower already described. The delivery pumps comprise four sets of Worthington high-lift pumps, each having a capacity of 700 gallons per minute, and delivering water into a 15in. main at a pressure of 80 lb. per sq. in. The pumps are driven at 1430 revolutions per minute by 3-phase 50-cycle 70 brake horse-power motors, made by the Macfarlane Engineering Company, Ltd., of Cathcart. All the motors are equipped with the new Brookhirst star delta starting switchgear, which was illustrated and described in our issue of June 22nd. In this type of starting pillar there is virtually an oil immersed starter, combined with a circuit breaker, and the correct sequence of movements are made automatic by means of a ratchet handle of patented design. Should the handle be released before the complete starting operation has been performed, the circuit breaker is tripped and can only be re-set by again returning the handle to the "off" position. In case of overload or failure of supply, the circuit breaker is free to operate both during and after starting has been effected.

The trips are furnished with a restrainer of patented design, which has the effect of providing two overload settings, one applicable during starting and the other when running. Actuated by the main operating handle, the restrainer is so arranged that during the starting operation the overload release acts immediately the starting current is exceeded.

Protection in starting is thus given both against severe disturbances and short circuits. The restrainer continues to act for a short period after the running connection has been established in order that the peak current may be given time to die down, while a subsequent movement of the operating handle removes its effect so that the overload tripping device will immediately act should the current exceed the predetermined value allowed in the normal overload setting.

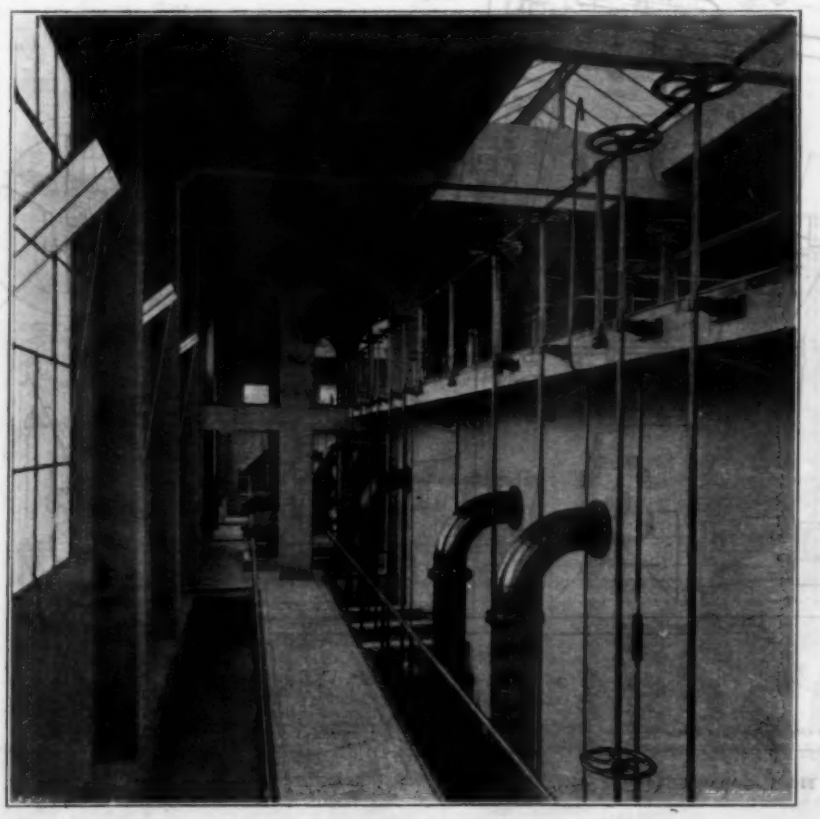


FIG. 7—LOWER PLATFORM SHOWING FILTERED WATER OUTFLOW CHANNEL

The pumps on the pier are also by the Worthington Company and are four in number. The two larger ones are designed each to discharge two million gallons of water per twenty-four hours, and the two smaller pumps each have half the capacity of the larger ones. A platform erected between the supporting piers of the jetty and reached by ladders communicating with the motor room immediately below the rail track serves as a pump platform, the pumps and motor being connected by intermediate shafting. The driving motors are of the three-phase squirrel-cage type, designed for 440-volt 50-cycle current. The larger pumps are driven by 70 brake horse-power motors at a constant speed of 715 revolutions per minute, while the small pumps are coupled to 35 brake horse-power motors running at 940 revolutions. The switch contacts comprise a six-panel pedestal type board arranged so as to accommodate the two incoming feeders and the four motor circuits. All the switchgear and cables were supplied by Johnson and Phillips, Limited, of Charlton, London, which firm also equipped the sub-station, where the power supply is received from the 6000-volt high-tension mains of the Woolwich Corporation, and is transformed down to supply the motors driving the pumps in the filter house and on the pier.

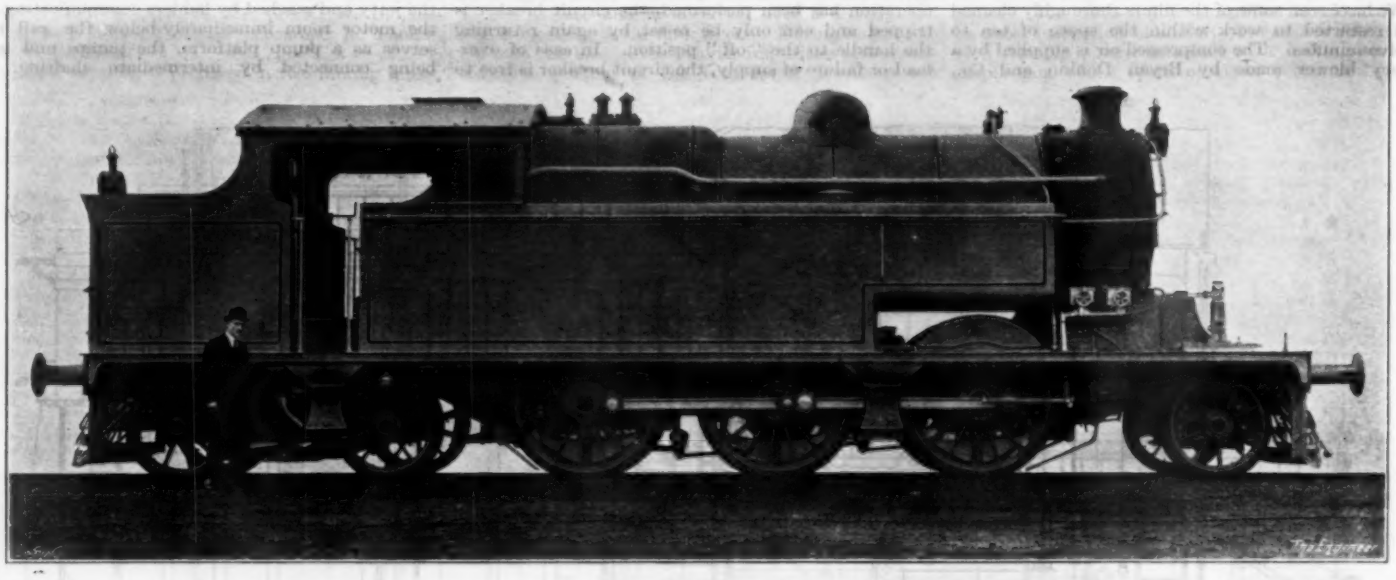
A sub-station of the usual design, with the transformer cubicles below and the high and low-tension switchgear above, has been built, and room has been left for further extensions. At the present time the equipment includes two 500-kilovolt-ampère 6000 to 540-volt three-phase 50-cycle self-cooled transformers, by Johnson and Phillips, with truck-type panels. On the low-tension side a six-panel draw-out type switchboard provides control for the two transformers and the four outgoing feeders to the filter house and the pier. The cables to the filter house are two three-core cables laid solid in stoneware troughs, and in the house itself is a distributing board for the eight-motor circuits and the two incoming feeders. The illustrations—Figs. 5 and 4—show an interior view of the sub-station, and the pedestal-type switchgear in the motor room under the pier.

It is of interest to note that the filtered water is used throughout the works for all purposes excepting boiler feed and drinking water. Among other examples we noted coke quenching, gas cooling, and steam condensing, working hydraulic machinery, and for cooling the fire bars of the gas producers for the testing retorts. We are indebted to Mr. W. B. Leech, the resident engineer of the Gas Light and Coke Company at Beckton, for the facilities given us to inspect the plant during its construction and since it was put into operation in May of this year and for help in the preparation of this article. We have also to record our thanks for assistance received from Mr. J. L. Gilbert, who designed the plant and supervised its construction on behalf of the United Water Softeners, Limited.

The Research Department, Woolwich, has published a description of an X-ray equipment, designed and constructed at Woolwich, which has been installed in the Army Veterinary School at Aldershot—R.D. Rep. No. 56. It consists of a large teak table-top to which the animal can be strapped while in the vertical position. The X-ray tube box is mounted on a carrier which enables it to be moved into any position relative to the animal, and the examination may be made or radiographs taken with the animal in the upright position. Alternatively, the table top may be rotated and moved on rollers so as to bring the aninal into the horizontal position over a supporting table. The X-ray tube used is of the standard Coolidge type, completely enclosed for protection in a lead box, and the generating set is designed to supply currents up to 20 milli-ampères continuously at 150,000 volts. Full details of the apparatus are given.

BOMBAY, BARODA AND CENTRAL INDIA RAILWAY—SIX-COUPLED TANK ENGINE

SIR W. G. ARMSTRONG, WHITWORTH AND CO., LIMITED, ELSWICK, ENGINEERS



Six-coupled Tank Locomotives for India.

A CONTRACT for sixteen tank locomotives for the Bombay, Baroda and Central India Railway, has recently been completed by Sir W. G. Armstrong, Whitworth and Co., Limited, and we are enabled in what follows to give illustrations and particulars of what has been in many ways a noteworthy accomplishment. The contract for these engines was received on November 16th last, and was let on the distinct condition that the whole of the work was to be completed and packed and shipped at an English port by March 31st this year. That date was, as we understand, actually anticipated, and when account is taken of the fact that the design was new, so far as the builders were concerned, and necessitated the preparation of new drawings, patterns, tools, &c., it will be seen that a very smart piece of work was performed. The contract was carried out to the designs and under the inspection of the company's consulting engineers, Messrs. Rendel, Palmer and Tritton, and the general design of the engines follows the usual practice of the Indian State Railways.

The boiler, which is of the Belpaire type with a copper fire-box, has a total heating surface, without superheater, of 1195 square feet, a grate area of 27 square feet, and is fitted with a superheater of the Marine and Locomotive Superheaters, Limited, type, with 21 elements, adding a further 260 square feet of heating surface, or a total of 1455 square feet. The diameter of the boiler at the fire-box end is 5ft. 1¼in. outside, and the length between tube-plates is 11ft. 4½in. There are two safety valves of the Ross pop type, 3in. diameter, set to blow off at 160 lb. per square inch. The boiler-feed is effected by a Weir feed pump on the left-hand side, and a Gresham and Craven injector on the right, the delivery to the boiler being through clack-boxes fitted on top of the boiler near the front end.

The frame plates, which are of steel and ¾in. thick, are set in at both ends in order to provide clearance for the bogie wheels when the engine is on a curve. The cylinders are 20in. diameter and 26in. stroke, and are placed between the frames, the two cylinders with their valve chests being in one casting. The piston valves are of a simple type and are 8in. diameter. The valve gear is of the Stephenson type with rocking shafts. The crank axle is a solid forging with oval webs fitted with hoops. Lubrication of the cylinders and coupled axle-boxes is effected by Wakefield mechanical lubricators. The total weight of the engine in working order, with 2500 gallons of water and 4 tons of coal, is 88 tons, the weight on the coupled wheels under these conditions being 53.35 tons.

The reversing gear is of a new type, designed and patented by the builders, and it has, so we are informed, proved very satisfactory on trial. The chief aim in working out this gear was to provide a locking device which would overcome the well-known tendency of most power reversing gears to allow the motion to creep when the engine is running. To achieve this object Messrs. Armstrong have drawn on their extensive experience in overcoming similar problems in gun work. The trials demonstrated that in the gear actually built the constituent parts remain rigidly fixed where placed. We give in Fig. 1 a drawing showing the arrangement of the whole gear, of which the following is a detailed description. It consists of two portions, one a hand mechanism operated by a hand wheel, for use when there is no steam available; and the other a steam gear, the power unit of which is a steam cylinder having coupled to it in tandem an oil cylinder. This cylinder acts as a speed control and positive locking device. The two gears are so arranged—the hand mechanism being directly over the steam gear, as will be seen in the illustrations—that by the withdrawal of one pin and the raising of the reversing rod end to the level of the hand gear, threading the same pin through the hand gear and reversing rod, the change is made from power to hand. The pin in question is fitted with a simple device for locking it in position. The hand gear consists of a modified form of the usual screw reversing gearing A—Fig. 1—

FIG. 1—ARRANGEMENT OF REVERSING GEAR

mounted on the side tank top, and provided with two thrust collars.

The steam cylinder B is of the usual form, with a slide valve C operated as shown. The forward end of the piston-rod of this cylinder passes into the oil cylinder. The oil cylinder, with its control valves, the leakage pump, and oil reservoir form a complete unit—Fig. 2. The piston D for this cylinder is fitted with two cup leathers E, supported by brass rings F, and between the leather and supporting rings are spring rings G, the shape of which is similar to that of the leather. The purpose of these springs is to give the leathers an initial pressure against the cylinder walls and perimeter of the piston. The rings are drilled and grooved to ensure the oil having easy access to the inside of the cup leathers E.

The piston-rod stuffing-boxes are fitted with the same type of leathers, spring rings and supporting rings as the piston. Above the cylinder in separate pockets H are two mitre control valves J. On the underside both valves open into the same pocket K in which is the mechanism for operating the valves. To enable the operator to get all air out of the system, two air cocks L are fitted, these tap the valve pockets H at their highest part.

The duties of the leakage pump are to keep the cylinder passages, valve pockets, &c., full of oil at a minimum pre-determined pressure and to make up any leakage. The pump is designed to carry out these duties automatically except when the hand lever M is at the end of its quadrant marked "Empty." When the hand lever M is moved from position marked "Empty" to that marked "Full," the plunger N is drawn out against the pressure of the spring O. The spring O will then exert sufficient pressure upon the oil to the cup leathers to open and keep them tight at all times. Whenever the pressure in the cylinder falls below the pre-determined figure, the hand lever M at the same time will creep to the position "Empty."

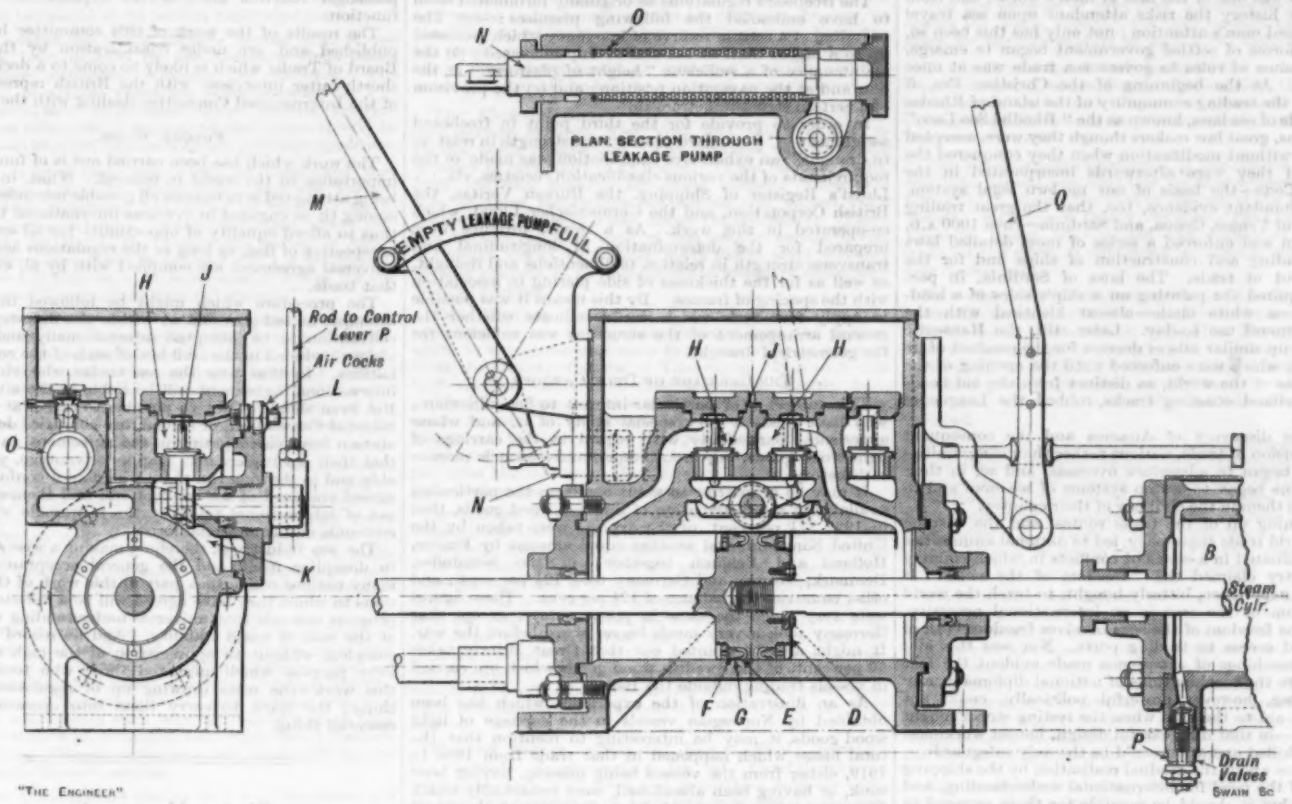
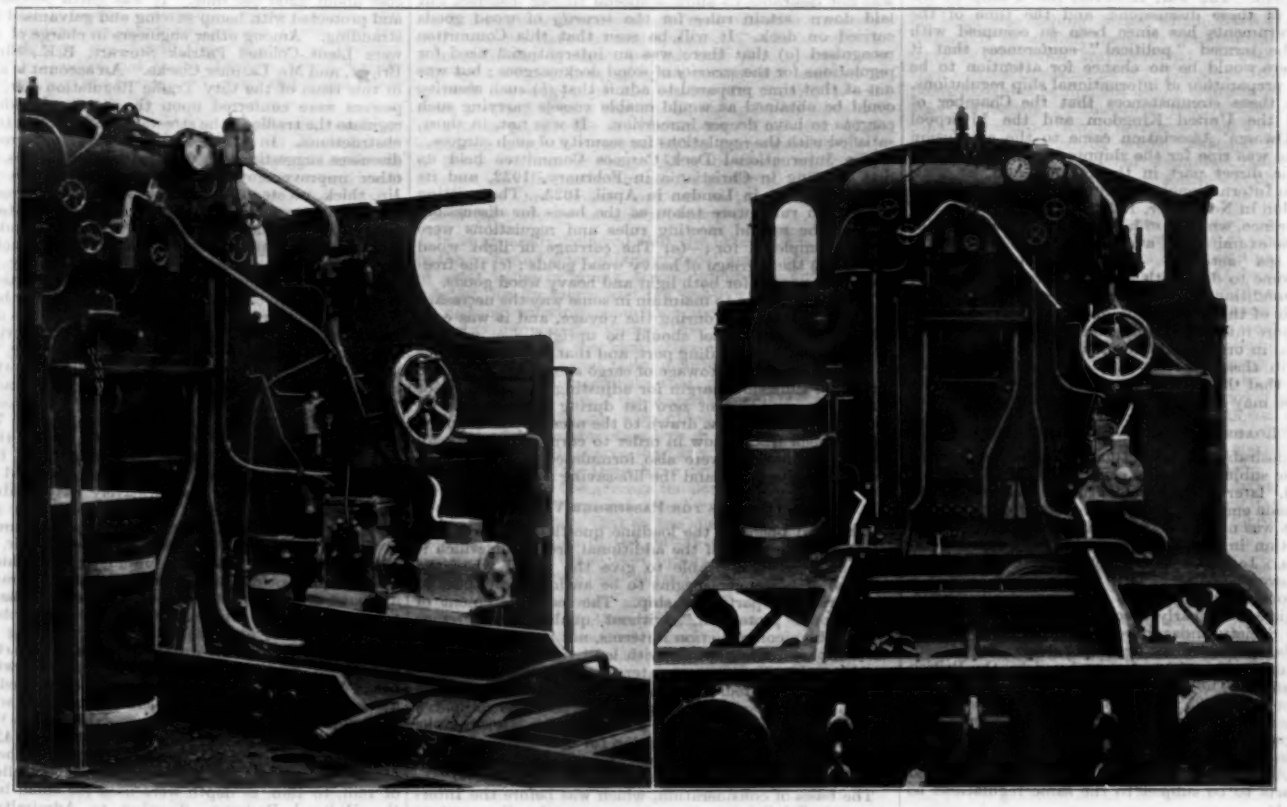


FIG. 2—OIL LOCKING CYLINDER FOR REVERSING GEAR

When the gear is set as required by the driver, the hand lever P must be returned to the position marked "locked," and hand lever Q to mid-position. This latter movement relieves the oil cylinder and its cup leathers of all pressure from the steam cylinder.

To put the locomotive link motion in position for running forwards, the hand lever Q is first moved in the direction marked "forward." This admits steam to the rear side of the piston, but no movement takes place until the operator moves the hand lever P from the locked position. The oil cylinder then provides an absolutely positive control to the movement, the speed of the reversing gear depending upon the amount the lever P is moved, and the gear becomes locked immovably directly the lever is moved to the "locked" position.



FIGS. 3 AND 4—VIEWS OF DRIVING PLATFORM SHOWING REVERSING GEAR

Regulations for Loadlines, Deck Cargoes and Safety of Life.*

By SIR WESTCOTT STILE ABELL.

The ship was one of the first of man's works, and from the earliest history the risks attendant upon sea travel have occupied man's attention; not only has this been so, but when forms of settled government began to emerge, the importance of rules to govern sea trade was at once recognised. At the beginning of the Christian Era, if not before, the trading community of the island of Rhodes set up a code of sea laws, known as the "Rhodial Sea Law." The Romans, great law makers though they were, accepted these laws without modification when they conquered the island, and they were afterwards incorporated in the Justinian Code—the basis of our modern legal system. There is abundant evidence, too, that the great trading Republics of Venice, Genoa, and Sardinia—*circa* 1000 A.D.—laid down and enforced a series of most detailed laws for the loading and construction of ships and for the carrying out of trade. The laws of Sardinia, in particular, required the painting on a ship's sides of a loadline mark—a white circle—almost identical with the mark in general use to-day. Later still, the Hanseatic League set up similar sets of decrees for the conduct of its sea traders, which were enforced until the opening of the ocean routes of the world, as distinct from the old headland-to-headland coasting tracks, robbed the League of its power.

With the discovery of America and the consequent rapid expansion of trade, nations rather than communities of traders began to adventure overseas, and so, in their turn, nations began to set up systems of sea laws and to incorporate them in the civil law of their country.

The opening up of the trade routes, and the ensuing race for world trade supremacy, led to national animosities which culminated in a series of conflicts in which country after country claimed the "freedom of the seas." It was left to experience, bitterly bought, to teach the world that freedom of the seas is an international necessity, and that the freedom of the seas involves freedom both of ship and of access to trading ports. Nor was this all; the stern teachings of experience made evident the fact that, despite the machinations of national diplomacy, any national flag, however powerful politically, could not render any aid to the ship when the tossing storm sought to prove it—in that day, careful design, honest workmanship, and skilled operation could be the only safeguards.

Thus came about the gradual realisation by the shipping industry of the need for international understanding, and the belief that it should be possible for those engaged in shipping to frame a standard of conduct which would be fair to all communities taking part in the international industry of sea trade. For a long time the political machinery of the various countries interested in maritime affairs was used to further this ideal.

It was apparent, however, that an internationally recognised code of regulations applicable to overseas trade was necessary; and the great Convention called in London after the Titanic disaster led to the idea that it would be desirable to hold an International Conference on the question of loadline. The committee appointed for that purpose reported to the British Board of Trade in December, 1915. The war, however, put a stop to the furtherance of these discussions, and the time of the various Governments has since been so occupied with what may be termed "political" conferences that it appeared there would be no chance for attention to be given to the preparation of international ship regulations.

It was in these circumstances that the Chamber of Shipping of the United Kingdom and the Liverpool Steamship Owners' Association came to the conclusion that the time was ripe for the shipping community itself to take some direct part in the matter, and, at their invitation, an International Conference of Shipowners was held in London in November, 1921.

This conference, which is of historic importance, had for its motive the examination and discussion of the various phases of sea activity. Several committees were appointed, some to deal with legal matters, some to deal with trade conditions, and others to deal with the ship herself. It is of these latter committees—with which the writer was more intimately connected—that some account will be given, in order that the great progress which has been made in these matters may be fully appreciated, and in order that the manner in which some of the results were obtained may be explained in a broad way.

Loadlines for Cargo Vessels.

It seems desirable to recapitulate briefly the modern history of the subject. In the early part of last century, Lloyds—and, later other underwriting associations in England—made empirical rules for the assignment of freeboard, but it was not until 1870 that there was any great public agitation in Great Britain with regard to unseaworthy ships. In that year Samuel Plimsoll, whose name will be for ever associated with this question, raised a storm of popular protest by his extravagant allegations. Lloyd's Register was early associated with the subject. In 1875 the Society endeavoured to formulate a system of freeboards, and in 1882 definite tables were issued, practically concurrent with rules produced by the British Board of Trade. The first British Loadline Committee issued a report in 1885 containing tables for maximum loading which were largely based on the proposals of Lloyd's Register. The Merchant Shipping Loadline Act of 1890 made the marking of loadlines compulsory, and a subsequent Act of 1906 required all vessels using United Kingdom ports to be subject to the same regulations as British vessels.

The 1885 rules were adjusted in 1906, and from that time onwards British, French and German regulations were practically in agreement.

While at the present time many nations are in accord with these regulations, yet Norway still allows a somewhat smaller freeboard for small vessels, and in spite of many efforts the United States have not yet passed an Act making compulsory the marking of a loadline.

* Read at a meeting of the Swedish Naval Architects, Gothenburg, August 14th, 1923.—Abstract.

A special committee appointed by the Board of Trade to formulate freeboard regulations suitable for international application reported in 1915, and it is the report of this committee, consideration of which was suspended during the war, which was the basis for the work of the committee of the International Shipping Conference appointed to deal with this question.

The freeboard regulations as originally formulated seem to have embodied the following premises:—(*a*) The provision of a certain reserve of buoyancy which increased up to a higher limit as the size of ship increased; (*b*) the maintenance of a sufficient "height of platform" at the bow and at the navigation position; and (*c*) the provision of a certain structural strength.

In order to provide for the third point in freeboard assignment—"a standard of structural strength in relation to draught," an exhaustive examination was made of the requirements of the various classification societies, viz.:—Lloyd's Register of Shipping, the Bureau Veritas, the British Corporation, and the Germanischer Lloyd, which co-operated in this work. As a result, formulæ were prepared for the determination of longitudinal and transverse strength in relation to dimensions and draught, as well as for the thickness of side plating in association with the spacing of frames. By this means it was possible to apply four tests which would indicate whether the general arrangement of the structure was sufficient for the geometrical draught.

The Carriage of Deck Cargoes.

This subject is of particular interest to Scandinavians, who have made a very special study of it, and whose experience, particularly with regard to the carriage of light wood goods, has been unique, and—what is more—satisfactory.

It may be of interest to point out from the particulars available of the distribution of Swedish wood goods, that in 1922 37½ per cent. of the exports were taken by the United Kingdom, and another equal amount by France, Holland and Belgium together; of the remainder, Denmark, Norway and Germany took 12½ per cent., and other countries the balance of 12½ per cent. These figures were very much the same in pre-war days, except that Germany took a very much bigger share before the war. It might also be pointed out that Great Britain takes 50 per cent. of the Swedish wood goods which are carried in vessels trading outside the Baltic.

As an illustration of the experience which has been obtained by Norwegian vessels in the carriage of light wood goods, it may be interesting to mention that the total losses which happened in that trade from 1906 to 1919, either from the vessels being missing, having been sunk, or having been abandoned, were remarkably small. There were no losses whatever in nine of the years mentioned—1906, 1908, 1910, 1911, 1912, 1913, 1914, 1918, 1919—only one loss per annum in the years 1909 and 1916, and two losses per annum in 1907, 1915, and 1917.

The British Loadline Committee of 1915 recognises that:—"In certain cases where ships are specially constructed, or specially fitted, for the carriage of wood goods, it might be contended from some points of view that timber-laden vessels could be loaded more deeply than other vessels, provided it could be guaranteed that the special conditions required were fulfilled."

It reported that, on the whole, it was of opinion that it was not desirable to allow a special timber loadline, but laid down certain rules for the *security* of wood goods carried on deck. It will be seen that this Committee recognised (*a*) that there was an international need for regulations for the *security* of wood deck cargoes; but was not at that time prepared to admit that (*b*) such security could be obtained as would enable vessels carrying such cargoes to have deeper immersion. It was not, in short, satisfied with the regulations for security of such cargoes.

The International Deck Cargoes Committee held its first meeting in Christiania in February, 1922, and its second meeting in London in April, 1923. The existing Norwegian rules were taken as the basis for discussion, and at the second meeting rules and regulations were finally completed for:—(*a*) The carriage of light wood goods; (*b*) the carriage of heavy wood goods; (*c*) the freeboard allowances for both light and heavy wood goods.

It was important to maintain in some way the necessary stability of the vessel during the voyage, and it was considered that the vessel should be upright, *i.e.*, without a list, on leaving a loading port, and that the arrangement of water ballast and stowage of cargo should be such as to provide a sufficient margin for adjusting the stability, or rather the condition of zero list during the voyage. In addition, attention was drawn to the necessity of supporting the deck from below in order to carry the deck load. Various regulations were also formulated to protect the crew, the navigation, and the life-saving appliance.

Loadlines for Passenger Vessels.

The third phase of the loadline question resolves itself into a consideration of the additional protection which it may be deemed desirable to give the vessel when the carriage of passengers begins to be an important part of the work of a particular ship. The mere statement of "additional protection," without qualifications, seems itself to be a contradiction in terms, not because travel at sea compares unfavourably with land traffic in respect of accidents, but because a greater measure of protection—passengers being regarded as "light and bulky" cargo—is economically possible in a passenger vessel as compared with a purely cargo ship. This was the view of the problem taken by the Convention for the safety of life at sea, which associated the provision of safety with the nature of the service of the vessel.

The basis of consideration, which was before the International Subdivision Committee, was the Convention, the work of the British Bulkhead Committee, and the reports of the Joint Committee of the Liverpool Steamship Owners' Association and of the Chamber of Shipping, which had been at work since 1916, endeavouring to show the British Board of Trade that the regulations issued under the Convention did not pay sufficient regard to the economic conditions of passenger overseas traffic.

The International Committee concerned itself primarily with three broad questions:—(*a*) The standard of subdivision required for vessels which carried more than twelve, but not more than a relatively small number of passengers, *i.e.*, for vessels in which the cargo function was dominant; (*b*) the standard of subdivision for vessels in which the passenger function was dominant and the cargo carried was very small or almost negligible; and (*c*) the preparation of a definition which differentiated gradually and continuously between vessels in proportion as the passenger function grew at the expense of the cargo function.

The results of the work of this committee have been published and are under consideration by the British Board of Trade, which is likely to come to a decision very shortly after interviews with the British representatives of the International Committee dealing with the subject.

Future Work.

The work which has been carried out is of fundamental importance to the world in general. What, in effect, is being attempted is to remove all possible misunderstanding among th se engaged in overseas international trade, and thus to afford equality of opportunity for all sea traders, irrespective of flag, so long as the regulations accepted by universal agreement are complied with by all engaged in that trade.

The procedure which might be followed in all such attempts at self-government within the industry is for a convention to be accepted internationally and its provisions included in the civil law of each of the contracting nations. In that way the sea trader who violates the international agreement will be liable in the civil courts. But even should it not be possible to arrive at an International Convention, or should any countries deliberately abstain from participating in the agreement, in the hope that their sea traders may reap an advantage, yet inevitably and in the long run those who do not conform to the agreed standard of sea conduct will find themselves shut out of international trade by the inexorable working of economic and commercial forces.

The sea industry is, therefore, making a wise endeavour to discipline itself, and the general acceptance by the many nations which took part in this work of the regulations to which they have agreed will be a milestone in the progress towards that universal understanding which lies at the root of world stability. And no record would be complete without an appreciation of the high spirit and lofty purpose which animated those who took part in this work—the mere drawing up of regulations is one thing; the spirit to carry them into operation is the essential thing.

Sixty Years Ago.

The Engineer for August 14th, 1863, opens with an article describing the submarine cable which in the following year was laid between Shat-el-Arab, at the head of the Persian Gulf and Guaddel, a town on the Mekran coast, where it was connected by land to Karachi and other parts of India. The telegraph route from Great Britain to India was thus completed *viâ* Constantinople and Baghdad the then existing landlines being used. The cable, some 900 nautical miles in length, was made at Henley's and the Gutta Percha Company's works, and cost about £200 per mile. It was gutta percha covered and protected with hemp serving and galvanised iron wire stranding. Among other engineers in charge of the work were Lieut.-Colonel Patrick Stewart, R.E., Sir Charles Bright, and Mr. Latimer Clarke. An account is also given in this issue of the City Traffic Regulation Act, whereby powers were conferred upon the Court of Aldermen to regulate the traffic in the streets of London and to prevent obstructions. In a letter to the editor a correspondent discusses suggestions for lightening locomotives. Among other improvements, welded steel boilers are proposed ¼in. thick, no steam dome, hollow connecting-rods, and a drastic shortening of the tender to form a tank locomotive. With the smaller water tank an extended use of a water trough placed between the rails at each station was proposed, in order that an ample supply of water might be maintained. One of our leading articles upon Iron Girders gives an interesting account of the change from cast iron girders to deep rolled steel girders of various types. As examples of the former type, a bridge over the Severn at Stourport is cited. In it, Mr. Rastrick used half-span girders cast 20ft. long with a depth of 18in. and a thickness of 2¼in. Cast iron girders made about 1840 for some of the swing bridges on the Amsterdam and Rotterdam Railway were cast in lengths of 75ft. 6in. Prior to 1863 few rolled steel joists deeper than 12in. had been made, and most of these came from France, it being supposed that the French iron possessed qualities that permitted of the comparatively easy production of deep sections with broad thin flanges. The American mills were the next to take up the manufacture of such beams, and a special process, patented by Mr. William Bridges Adams in 1847, was employed. By this method the top and bottom flanges were finished separately with a groove in each, in which the plate forming the web was temporarily keyed, the girder so built up was then raised to welding heat and passed through finishing rolls. A later process, of which we read in the same article, was introduced by the Butterley Company, in which two heavy tee irons were first rolled and then welded together along one edge of each. Beams 3ft. deep with 12in. flanges made by this process were exhibited in the International Exhibition of 1862, and depths of 42in. were spoken of. Apparently one drawback was the amount of metal which was put into the flanges, but rolled beams of 16in. to 18in. in depth were used for small bridges on the Midland Railway. Turning to Admiralty affairs, we find particulars given of the iron-cased frigate Bellerophon, 300ft. in length and 50ft. in breadth, designed by Mr. Reed, which was to be laid down at Chatham as soon as the resources of that establishment permitted the work to be begun. The armament included twelve guns, and the armour plate with which the vessel was encased was 5½in. in the most exposed parts and 4½in. in other portions of the vessel. It was proposed to install 1200 horse-power engines, giving a speed of 15 knots, and the time allowed for building was two years.

Railway Matters.

The Council of the Railway Administration at Reval has approved of the estimate for the electrification of the railway line Reval-Nommo and for some new construction necessary for carrying out the whole project. The cost is estimated at 34 million Esthonian marks.

It is reported by the *Melbourne Herald* that it has practically been decided by the Railways Department to introduce automatic couplings in Victoria. The advantages of several types are being considered. The fast services now maintained under electric traction in the urban area make it imperative that trains should be made up and brought into use with the greatest expedition.

In our Journal page last week, we mentioned that the National Union of Railwaymen and the various crafts' unions concerned had failed to come to terms as to the shopmen's bonus. In this connection, the following remarks by Mr. J. H. Thomas are worthy of note: "Every effort was made to try and effect a settlement, because we felt that on a domestic matter it was for the unions themselves to settle their differences."

Announcement is made of two interesting appointments arising out of grouping. The first is that Mr. E. A. Clear, the assistant general manager, Great Central Railway, has been made assistant divisional general manager, southern area, London and North-Eastern Railway. The second is that Mr. F. A. Brant, of the South-Eastern and Chatham, is the continental traffic assistant to the general manager, Southern Railway.

The West Coast main line near Lockerbie was obstructed by a landslip on Thursday, the 9th inst. The Glasgow traffic was diverted on to the Glasgow and South-Western section, and the Edinburgh on to the Waverley route of the London and North-Eastern Railway until the obstruction was removed during the day. We make mention of this small incident in order to show how comparatively blessed British railways are for alternative routes.

A benefit of grouping is that the public is now informed of alternative routes of which, hitherto, it has been kept in ignorance. For instance, the service between Farnham and Guildford by the London and South-Western Railway was shown as "Weekdays Only," and nothing was said about the nine trains each way on Sundays from that company's station at Aldershot run by the South-Eastern and Chatham. This convenience is now made fully known on the South-Western section.

The new Underground station in Piccadilly-circus will be 15ft. below the road level with a large circulating area leading to and from six escalators—three for the Baker-street and three for the Waterloo and the Hammersmith-Finsbury Park lines. The middle of each set of escalators will be reversible, so as to be used for arriving passengers in the morning and departing passengers in the evening. There will be seven public entrances to the station, and the general public will be free to use the subways.

The union of the London and South-Western, South Eastern and Chatham, and London, Brighton and South Coast companies, has led to a revision of the names of those stations in the same town which have hitherto borne identical names. Dorking, South-Eastern and Chatham, for instance, becomes Dorking Town, and the London, Brighton and South Coast station is Dorking North. The London and South-Western Ewell Station is Ewell West, and the London, Brighton and South Coast is Ewell East.

The Badulla extension of the Ceylon Government Railway starts from Bandarawela at an elevation of 4100ft. above sea level and descends through mountainous country for a distance of 20 miles to Badulla, a provincial town situated in the midst of a large tea-growing district, at an elevation of 2000ft. above sea level. The railway has a 5ft. 6in. gauge, with minimum curves of 5 chains radius and a ruling gradient of 1 in 44. The nature of the country traversed made heavy earthwork and rock cutting unavoidable throughout.

In this column, on July 6th, mention was made of a through train from Liverpool, Lime-street, and Manchester, London-road, to the Norfolk coast *viâ* Stoke-on-Trent, Nottingham and the Midland and Great Northern Joint Line. This train runs non-stop from Stoke to Nottingham, *viâ* Stenson Junction and the little-used Castle Donington line. The Liverpool engine works the train to Nottingham. This service was, at first, done by the London and North-Western section engine, but, from August 1st, it has been performed by a Midland Division locomotive.

A correspondent, writing to the *Railway Age* (New York), suggests that the trainmen's unions and the organisation of the postal sorting clerks, as parties vitally interested, should co-operate to punish careless drivers of motor cars over level crossings. He says: "Experienced and tested enginemen who naturally safeguard their own lives, their trains and their passengers, are now the constant potential victims of motorists who are careless, or reckless, or full of hootch; or afflicted with defective vision or hearing, sometimes both. No physical or mental test is required before a man is granted the right to use a vehicle with express train speed which, perhaps, has defective brakes."

The projected amalgamation of the Southern Irish Railways was referred to in the Free State Parliament last week, when the Minister for Industry and Commerce was asked if it was a fact that five railway companies of the Free State had submitted an agreed amalgamation scheme to the Ministry, and whether it was only the present political situation that had caused the Government to postpone its acceptance. Mr. Blythe, in reply, said that five of the railway companies had submitted a provisional scheme of amalgamation. The Government was of opinion that the reorganisation of the railways must deal with the companies generally in the Free State, and, pending a scheme of general reorganisation, did not consider there was any advantage in proceeding with a proposal that related to particular companies only.

Notes and Memoranda.

In summing up a report to the American National Advisory Committee for Aeronautics, Mr. E. Buckingham condemns the jet system of propulsion, as compared with the ordinary propeller. The relative fuel consumption and weight of machinery for the jet decreases, he says, as the flying speed increases; but at 250 miles per hour, the jet would still take about four times as much fuel per thrust horse-power as the air screw, or propeller, and the power plant would be heavier and much more complicated.

The *Electrical Review* reports that a continuous air-mail service between New York and San Francisco is shortly being commenced. The airplanes will cover the distance of 3000 miles in 28 hours. To aid pilots at night, huge electrical beacons are being erected. These will turn at three revolutions per minute and project their beams at an angle of 3 deg. above the horizontal. There will be five beacons, each of 600,000,000 candle-power, at Chicago, Iowa City, Omaha, North Platte, and Cheyenne. Smaller beacons, at 25-mile intervals, will mark emergency landing grounds.

The Mexican Government intends to change the apparatus in use in its radio stations from the present spark to the continuous-wave type, according to a report from the Director-General of Telegraphs. It is said that four modern stations of this class have already been ordered from Germany at a cost of 200,000 dollars. They are to be installed in Mexico City, Merida, Vera Cruz, and Tampico. Stations of the old spark type which already exist at these points are to be transferred respectively to the Islas Marias; in La Paz, Lower California; Guadalajara, Jalisco; and Acapulco, State of Guerro.

Accidents in coal mines in the United States during June caused the death of 172 men. The fatality rate for the month, based upon a production of 54,155,000 tons, was 3.15 per million tons. For the corresponding month last year the rate was 4.91. An average of 4.28 deaths per million tons is shown by the record for June during the past ten years. The fatalities in June brought the total deaths for the first half of the current year to 1221, indicating a fatality rate of 3.76 per million tons, as against 868 fatalities in the same period last year representing a rate of 4.14. The fatality rate for the present year represents a reduction of more than 9 per cent. from the 1922 figures.

Modern science, states *Oil Engine Power*, decreases the hazards of prospecting for oil. Careful records, geological maps, well maps and production data are kept, so that the experience of each well may add to the new science of petroleum engineering. Rock samples are taken from the well to the geologist's laboratory, are reduced in size until the largest piece has the diameter of about $^{1}/_{32}$in., the small pieces carefully washed, and the particles thoroughly examined through the microscope. Often the presence of fossils or certain minerals is discovered only after long and tedious search. When once found and correctly placed in the geological column they become of great value in detecting oil-producing formations.

The mercury mine of Dong-shun-hsien, Kwei-chow, China, has been, it is said, in operation since the Ming Dynasty, 1368–1644. The veins are found in the limestone strata and in isolated patches or pockets. There are two kinds of mercury ore. One is red and transparent and the other dark-red and opaque. The latter contains a small amount of antimony, but both contain no pyrite. The methods used in opening the mine and in smelting the mineral are very poor and crude. In opening a mine holes are drilled to a certain depth, and into them 2 lb. or 3 lb. of gunpowder are introduced. The result of the explosion after the ignition of the gunpowder is 200 lb. to 300 lb. of mercury ore. After breaking up the rock it is put into the native furnace for smelting. The furnace consists of three boilers and one earthenware basin, in which the mercury vapour is condensed.

It is generally believed that the extensive use of glass in the roofs and sides of factory buildings, whilst obviously of great value in giving a well-illuminated and cheerful interior, has in bright and hot weather the disadvantage of making working conditions inside the building extremely oppressive. Whilst this may be true for a factory in which the ventilation arrangements are not highly efficient, some tests mentioned in the *Chemical Trade Journal* demonstrate that when efficient natural ventilation is provided the disadvantage does not exist. The results in question were obtained in a works which has probably a greater glass area in the roof and sides per unit of effective floor area than any other factory building in the world. The tests have proved that during the recent heat wave the average temperature inside the shops when working at normal speed was actually lower by several degrees than that in the shade outside. There is nothing remarkable in the nature of the glass, but particular care was taken that means were provided for an effective and purely natural circulation of air.

Assays of a number of representative samples of oil shale from the New Albany (Ind.) district, made by the United States Bureau of Mines in co-operation with Indiana University, disclosed an oil yield varying from 4.8 gallons to 15.7 gallons per ton. The average oil yield for all shale samples tested was 10.3 gallons per ton. The specific gravity of the crude oil varied from 0.924 to 0.955, the average being 0.943. The amount of tops from the crude oil varied from 38.8 to 52.9 per cent., the average being 44.1 per cent. Apparently the percentage of tops varies inversely with the oil yield, that is, the less the oil yield the greater the percentage of tops. The exact reason for this is not clearly understood, but it is believed that in retorting a lean shale, at the same rate as a rich shale, there is less mechanical carrying over of the primary decomposition product of the shale kerogen, and consequently the primary decomposition product is more completely broken up, yielding a crude oil with a higher percentage of tops. The tops, after standing a few days, become intensely red-black in colour, and if allowed to stand open and evaporate slowly, a small quantity of resinous gum-like material is deposited. This is a characteristic of cracked oils.

Miscellanea.

A large wood pulp and paper mill is to be put up at Fort Alexander, Winnipeg, at a cost of about a million pounds sterling.

For the purpose of providing a satisfactory system of sewers for North Toronto, the City Council has endorsed plans for the expenditure of 11,121,525 dollars.

Trade figures for British India to the end of the last fiscal year show, states *Eastern Engineering*, that there is a moderate trade with Japan in electrical apparatus, though there has been a drop in this class of imports since the previous year.

The Metallurgical Department of Manchester University will take formal possession of its new quarters on September 11th, during the visit to the city of the Institute of Metals. Sir George Beilby, formerly head of the Fuel Research Board, who himself had conducted important work on the effect of cold work on metals, will open the new department.

The scheme for the extension of the Canadian Westinghouse Company's fac'o'y includes the construction of a 200,000-dollar unit addition to its West Hamilton works. The company has in prospect a building programme amounting to 1,500,000 dollars to accommodate the increased plant required to provide for a number of large orders for water power development machinery recently received.

At a conference recently held between representatives of the Marine Section Committee of the Society of Motor Manufacturers and Traders, Limited, and of the Ship and Boat Builders' Association, steps were taken with a view to co-ordinating the future activities of these two important bodies. As a result of this conference a co-ordinating committee will be set up consisting of four members from each body with their respective secretaries.

Applications are invited for the Yarrow scholarships in connection with the Institution of Civil Engineers. The scholarships vary in value from £50 to £100 per annum, and are open to British subjects who, desiring to become engineers, lack sufficient means to enable them to pursue their practical or scientific training. The regulations concerning the scholarships are obtainable from the Secretary of the Institution of Civil Engineers, Great George-street, Westminster, S.W. 1. The latest date for the receipt of applications is September 30th.

As a result of a conference held recently between representatives of the leading insurance companies issuing motor car policies and the Council of the Institution of Automobile Engineers, the Institution has prepared a list of all its members who are prepared to undertake work in connection with examination, assessing repairs and technical work on behalf of the insurance companies. On their part, the companies have promised to make use of the services of members of the Institution of Automobile Engineers wherever possible, in preference to those of non-members.

The chief of the Nagasaki Prefectural Marine Products Bureau, Japan, together with a committee of men interested in marine products, is reported to be investigating the possibilities of installing wireless telephone equipments on large size fishing boats which have their base at Nagasaki, to enable them to communicate with shore when in difficulties, and to report the catch in time for their owners to realise on it. There are about 150 fishing boats on which equipment might be installed, and though they frequently go distances from shore too great for direct communication, it is believed that a system of relays could be developed by which messages could be sent through to land. Sets of Japanese manufacture will doubtless be favoured where suitable equipment can be obtained locally.

A great national congress of engineers, working in fifteen sections, opened on the 8th inst. at Gothenburg. In an introductory discourse on the conditions of Swedish industrial life, the chief engineer, M. Svedberg, pointed out that apart from cultivated land Sweden's natural resources consisted of forests, ore deposits and water power. As regards ore the prospects were very bright, an undiminished export of iron ore being possible for hundreds of years to come. The recently found copper and sulphur deposits bid fair, he said, to render Sweden to a large extent independent of imports. The total water energy available in Sweden was calculated at 6,750,000 turbine horse-power, out of which about 1,300,000 were already exploited, and a further 2,200,000 could be exploited during the next forty years. The lecturer emphasised the fact that even if this further exploitation of water power were completed at once it would still be necessary to import annually about 1,500,000 tons of coal and 90,000 tons of mineral oil.

From all parts of Great Britain delegates were recently present at Nottingham, at the annual conference of the Colliery Officials' Federation, when attention was directed to many important considerations regarding the use of electricity in connection with mining work. The organisation represents a membership of 10,000, and Mr. J. P. Houfton, a past-president of the Institute of Mining Engineers and one of the directors of the Bolsover Colliery Company, emphasised the consideration that in connection with improving the safety of life the increasing use of electrical arrangements was becoming of paramount importance. He believed that he was the first to institute electrical haulage in a mine. There was, in his view, no end to the possibilities of the use of electricity in mines, as difficulties were increasing as collieries were becoming deeper. It was now common in the area east of Doncaster to raise coal from a depth of 900 yards. As these pits became exhausted, it would be necessary to go deeper still and to find how workings, 1500 yards below the surface, and with a natural temperature of over 100 deg., could be kept cool enough to enable men to work therein. In that connection electricity as a motive power must necessarily play an essential part in solving difficulties inherent to deep mines as to many other colliery workings.

REINFORCED CONCRETE SEAPLANE HANGAR AT COPENHAGEN

(*For description see page* 180)

FIG. 1—ROOFING BEING GOT INTO POSITION

FIG. 2—INTERIOR VIEW OF HANGAR

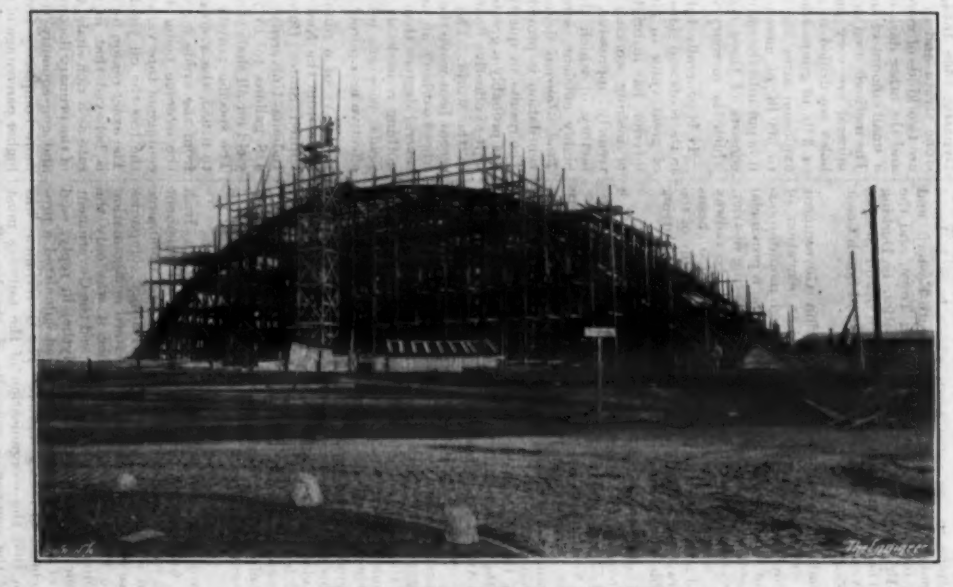
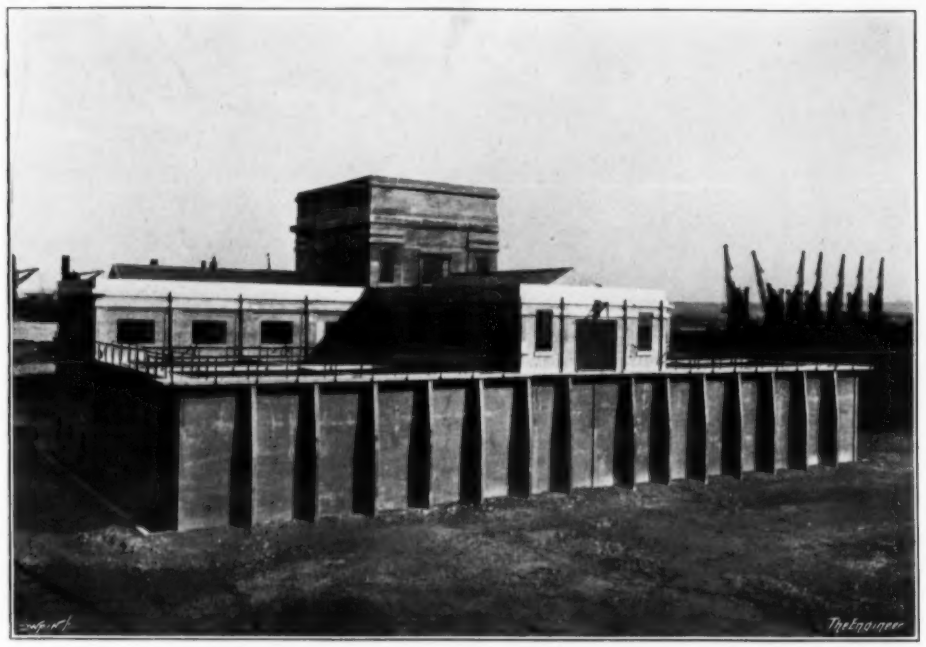


FIG. 3—GENERAL VIEW OF SCAFFOLDING

FIG. 4—SIDE VIEW SHOWING REINFORCEMENT OF ARCHED RIBS

PURIFICATION PLANT FOR THAMES WATER AT BECKTON GAS WORKS

REINFORCED CONCRETE FILTER AND PUMP HOUSE



REAR VIEW OF FILTER HOUSE SHOWING SETTLING BASINS

LIME MIXING TANKS WITH MEASURING AND RECORDING APPARATUS

UPPER CONTROL PLATFORM IN FILTER HOUSE

REINFORCED CONCRETE CONSTRUCTION BENEATH FILTERS

ENTRANCE HALL, SHOWING PUMPING PLANT AND AIR BLOWER

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Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Manager, all other letters to be addressed to the Editor of The Engineer.

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PUBLISHER'S NOTICES.

*** With this week's number is issued as a Supplement a Two-page Plate illustrating a Purification Plant for Thames Water at Beckton Gasworks. Every number as issued by the Publisher contains a copy of this Supplement, and Subscribers are requested to notify the fact should they not receive it.*

*** If any Subscriber abroad should receive* The Engineer *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconveniences, if suffered, can be remedied by obtaining the paper direct from this office.*

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*** All letters intended for insertion in* The Engineer *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

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AUGUST 17, 1923.

Marine Diesel Engine Working Costs.

A short time ago there was published in the form of a report, which was issued under the authority of the Diesel Engine Users' Association, a valuable collection of information regarding heavy-oil engine working costs. As is probably well known to our readers, the Association, which was founded in 1913, has carried out a programme of important meetings, at which were delivered lectures based upon the experience and work of many leading engineers, chemists, and others concerned with the actual running of Diesel and hot-bulb engines. The report in question is the outcome of arrangements made in the summer of 1922 to collect data of heavy-oil engine working costs from year to year, to which there was a praiseworthy response by a number of members, who furnished returns relative to their various installations for the preceding five years. From these returns the Association selected six representative installations with power outputs approaching one million units generated per annum, and with an annual plant load factor of at least 15 per cent. These six undertakings comprised five electricity supply companies and corporations and one waterworks company. It is to be observed that not a single marine installation is included, and indeed, on referring to the list of former papers and reports of the Association, it is seen that during its ten years of activity apparently only one paper—that on "Marine Diesel Engines," by Mr. H. F. P. Purday—has dealt ostensibly with marine Diesel engines, and it did so altogether apart from the broad economic question of working costs. The omission is all the more noticeable in that, either through the medium of individual representatives or by subscription, a number of leading firms of shipbuilders and a few shipowners, including the Admiralty, are directly interested in the work of the Association.

This leads us to an important observation. The data furnished by the various land undertakings to which our opening remarks refer were recorded and compiled in each case by the engineer of the company or corporation. The necessary investigations made by these engineers and the presentation of the results for the public benefit were obviously only rendered possible by the sanction of their directors and by the co-operation of the financial accounts departments of the undertakings. What would be the probable outcome of an appeal to shipowners for similar data on which to base a deduction of the average actual running cost of marine Diesel engines? Several difficulties, insuperable under present conditions in the motor shipowning business, become apparent immediately. First of all, there is the almost complete exclusion of the engineering staff from access to the financial accounts of ship management. The ignorance and indifference of the average marine engineer regarding the overall cost of his department is lamentable. If we turn to the marine engine builders ashore the position is practically identical, with the exception that in their case it is perhaps possible to establish the first cost of the machinery fitted in a vessel and the few spare parts supplied with it. As to whether there are many shipowners in a position to obtain, through their accounting departments, itemised costs of running, maintenance, and repairs of their ships' machinery, whether Diesel or steam, corresponding to the data contained in the D.E.U.A. report previously mentioned, we have reason for much doubt. Yet it is largely the absence of these very data which is responsible for the never-ending, humdrum argument as to which is the more economical, the steamship or the motor ship. It is fairly safe to infer that the outstanding technical merits and all-round practical advantages of Diesel engines for marine propulsion are the most weighty factors which have induced so many shipowners to decide in favour of motor ships. Working costs have had comparatively little to do with the decision. In fact, it may, we think, be asserted without fear of contradiction that records of working costs, whether of steam or Diesel engines, ascertained, not over a period of a trial trip or even an extended voyage of some months, but over a period of five years, as in the case of the land installations previously quoted, simply do not exist. At any rate, so far, those responsible for the business of marine transport have allowed a fog of mystery and suspicion—unfounded, we are sure—to arise and obscure information which, though elementary, is of immense importance to the marine motor industry, namely, the working cost per ton-mile of Diesel machinery as compared with steam installations over a reasonably long period.

It seems hardly possible to identify any one root cause of this state of affairs. If all marine Diesel engines were of one standard type, the property of some one firm and a number of subsidiary licensees, and if in the matter of experience and development we stood where we did fifteen or twenty years ago, such secrecy, or rather lack of information, as prevails could be understood, because the commercial success of the new departure might be jeopardised by the possibility of one or more individual cases of high working costs being made public. But in the present advanced stage of development of the marine Diesel engine its reliability and efficiency are beyond question. Moreover, extended experience on the part of the engineers in charge, and in addition keen rivalry between the designers of the many different types, have had the effect of virtually equalising the performances of the various makes of engines. Considerable interest is at present being taken by all classes of engineers and power users in the series of trials which is being carried out by a joint committee representing the Institutions of Mechanical Engineers, Naval Architects, and Marine Engineers, but it would seem to be unlikely that the scope of this committee's inquiries will include the determination over a period of years, under sea-going conditions, of the actual working cost of typical marine Diesel engines, for the constitution of the committee is essentially technical rather than commercial. We venture to suggest that there is urgent need for a systematic investigation into the working costs of Diesel engines at sea, on lines parallel with those adopted by the Diesel Engine Users' Association for land power plants. Such an investigation would certainly be of great potential value to the shipowner and shipbuilder alike, while as concerns the marine engineer, it should lead to an honest introspection and, we hope, a determination to make good the deficiency which undoubtedly exists between his *confrères* ashore and himself in the matter of engineering economics.

London's Water Supply.

It is always a pleasure to read the reports made by Sir Alexander C. Houston to the Metropolitan Water Board, of which he is, as our readers are well aware, Director of Water Examination. The documents are always so clearly expressed, and are so free from bewildering technicalities, that they are readily to be understood by the veriest layman, and yet they are of such high scientific value that they command the respect and attention of those concerned with water supply throughout the world. The seventeenth report, which deals with results of the chemical and bacteriological examination of the London waters obtained during

the year ended March 31st last, and a *résumé* of which is given in another column of this issue, provides as delightful reading, and is as highly instructive, as any of the series. It gives evidence of an immensity of work conscientiously and laboriously performed, and we have nothing but praise for the policy of the Water Board which has, without any reservations, consistently from the time it came into being, permitted the publication of these reports. Originally, it will be remembered, there was an annual report which dealt more or less exclusively with the routine work of the Water Examination Department, and there were also published, at intervals, research reports in which the results of Sir Alexander's investigations, as apart from routine analyses and observations, were detailed. Nowadays, the two reports are, as a measure of economy, merged into one, and it cannot, we think, be said that anything has been lost by the change.

The present report deals with matters which have been discussed in previous publications, and also with some entirely new questions. Chlorination is no new thing, for it was introduced as a war measure to save coal. But it has, the report tells us, proved to be so uniformly successful that its use has been continued, and will, evidently, be continued. We learn that during the year under consideration, no less a quantity than 23,013.5 million gallons of raw river water were successfully treated with chlorine, with, as a result, a saving of over £16,000, as compared with what the cost would have been had all the water had to be pumped. Actually, as much as 85 per cent. of the water abstracted from the Thames at Bell Weir was chlorinated, and only 15 per cent. had to be pumped into the reservoirs during times of flood, when, if for no other reason, storage in reservoirs was necessary so that the suspended solids, which otherwise would speedily clog the filter beds, might have time to settle out. Another direction in which investigations have been continued, and which is of very considerable value, is that of keeping a micro-photographic record of the suspended matters in the various waters. By means of this record it has been found possible in the past to foretell and to take measures to prevent superabundant growths of minute vegetable organisms, which, if permitted to develop, would play havoc with filter beds. The method by which the various samples to be photographed are prepared is most ingenious and, apparently, it provides a means whereby an accurate comparison is always possible between samples, no matter when they may have been prepared. Then, again, the study of pre-filtration waters has, as shown in the report, been carried several steps further. Whether by chlorination or by storage in reservoirs Sir Alexander is able to state confidently, that in by far the greater bulk of water an improvement of at least ten times, as compared with raw river water, has been effected; in a goodly proportion the improvement is one hundred times, while in a smaller proportion the improvement is as much as one thousand times. It is undoubtedly true that both the Thames and the Lee are polluted rivers, but it is also true that the water as supplied to consumers is of most wonderful purity. With no other evidence than the health of the Metropolis, that statement might be made with the utmost confidence, and when these annual reports are read every one must realise how it is that such excellent results are achieved.

There is something particularly attractive in the manner in which Sir Alexander takes his readers into his confidence in these reports of his. His evident desire is to hide nothing, and in the present report happenings are discussed which, had there been any such desire, might easily have been made the subject of private communications to the Board. For instance, there is the matter of one of the deep chalk wells in Kent, which generally are all of them noted for the high purity, both chemically and bacteriologically, of their waters. In the supply from one of them, however, *B. coli* bacteria suddenly made their appearance, and the presence of that organism is one of the indications of possible pollution. Measures were at once set on foot to ascertain, if possible, the source of the contamination, and, concurrently, steps were also taken to render the water absolutely sterile, and, hence, perfectly wholesome, by means of chlorine. Sir Alexander does not try to conceal any failures he may meet with. The reason for the presence of the *B. coli* bacteria in the well water was never discovered, and curiously enough the water suddenly, and apparently without any recognised cause, regained its pristine purity. All this we are told, and we are told, too, of the troubles experienced in the matter of taste in the treated water, and how those troubles were surmounted. Then, again, there is the question of the presence, evidently in considerable numbers, of *B. coli* in the West Middlesex reservoirs, which are ordinarily charged with chlorinated Thames water. It is, for various reasons into which we need not now go, a by no means unwarranted assumption to attribute this particular pollution to the presence of gulls which visit the reservoirs in large numbers during the winter time, finding them, as Sir Alexander suggests, a haven of rest and an excellent feeding place, since fish are plentiful. Likely as this assumption is to be correct, and harmless to human health as Sir Alexander evidently regards *B. coli* derived from the droppings of birds, he was not, and is not, content to sit down and take it for granted that the cause of the pollution is the gull. On the contrary, he has made special efforts to determine, by means of many different preparations of bacteriophages—the nature of which are discussed in the report—whether it were possible to differentiate between the *B. coli* of human origin and those derived from birds. So far he has failed, yet we do not think that it would be a prophecy likely to be falsified if we said that some day he will succeed. At any rate, whether he does so or not, one always has a feeling that, with Sir Alexander in charge of the Examination Department, the purity of London water is in eminently safe hands. He is such an ardent apostle of absolute purity in water supplies, that it is certain that he would never countenance any procedure which was not to be relied upon to give the very best results obtainable.

Locomotive Practice and Performance in France.

By J. T. BURTON-ALEXANDER.

No. III.*

On the Nord.

The last of the big companies with which I propose to deal is the Nord.

Up to lately the work of renewal was such that slacks and slows on all except the Paris-Calais line made time-keeping practically impossible, while all the engines were pre-war ones, for the new "Pacifics" were not then delivered. However, I was able to get some very interesting runs on the footplate and in the train.

During the war in December, 1916, I was able to time one train from Amiens to Paris, with 3.1161 and a load of 430 tons. From Amiens, in spite of signal delays, we passed Longueau, 3.1 miles, in 7 min. 55 sec.; La Faloise, 16.1 miles, in 25 min. 30 sec.; Breteuil, 21.3 miles, in 32 min. 20 sec.; Gannes, 26.6 miles, in 39 min. 30 sec.; Clermont, 40.1 miles, in 52 min. 15 sec.; Creil, 49.8 miles, in 61 min. 40 sec.; Survilliers, 62.7 miles, in 79 min.; and stopped in the Gare du Nord, 81.3 miles, in 99 min. 20 sec., or 96 min. net.

I will first of all deal with the internal services of the Nord and afterwards with the boat trains and their corresponding trains on the English side.

On the 6.20 p.m. to Brussels, with a load of nine coaches, or 303 tons, this winter, and engine 2.642 (the 1900 exhibition engine), we passed St. Denis, 4.3 miles, in 6 min. 10 sec.; Survilliers, 18.6 miles, in 21 min. 55 sec.; Chantilly, 25.4 miles, in 27 min. 50 sec.; Creil, 31.7 miles, at 31 m.p.h., in 33 min. 10 sec.; Compiègne, 52.3 miles, in 54 min. 35 sec., at 49.1 m.p.h.; Noyon, 67.1 miles, in 73 min.; Chauny, 77 miles, in 82 min. 45 sec.; Tergnier, 81.3 miles, in 87 min. 30 sec.; and stopped in St. Quentin, 95.6 miles, in 110 min. 45 sec.; but there were the following delays from relaying and signals:—A little while after passing Compiègne we ran for four minutes at 18 m.p.h.; at Tergnier we had a slack to 40 m.p.h.; and we were stopped twice for signals, the first time eight minutes after Tergnier, the second thirteen minutes. The relaying and signals delays cost us at least twelve minutes, leaving a net time of 98 min. 45 sec., a loss of 1 min. 45 sec., but still wonderful for a twenty-two-year-old engine. We were considerably handicapped by slipping on many occasions, even when running at high speed. At St. Denis our speed was 60.8 m.p.h., with 37 lb. pressure in the low-pressure cylinder, 42 per cent. admission, with 340 deg. Cent. on the pyrometer, and a three-quarter gauge glass. Our absolute minimum speed at Survilliers was 53.4 and on the descent to Creil it rose to 74.5 m.p.h. After Creil our speed reached 62.1 m.p.h., with a maximum of 63.3 m.p.h. before Chauny; after Tergnier it had risen from 49 to 54.6 m.p.h. before the signal stop; before Noyon we had to screw up the exhaust, the pyrometer marked 310 deg. Cent., but the exhaust soon brought the fire round.

From St. Quentin the slipping was bad, as the night was cold and misty. We passed Busigny, 16.7 miles, in 25 min. 40 sec., with a long relaying slow 12 min. after the start to 18 m.p.h.; Le Cateau, 21.3 miles, in 30 min. 55 sec.; Aulnoye, 38.4 miles, in 46 min. 40 sec.; and stopped at Feignies, 47.7 miles, in 56 min. 20 sec. gross, or 53 min. net. Our speed up the long bank out of St. Quentin had risen to 55.9 m.p.h. before the slow, and rose after it to 52.1 m.p.h., while after Le Cateau we only dropped to 55.9 m.p.h., our maximum speed being 68.3 m.p.h. at Busigny. The pyrometer marked between 330 deg. and 340 deg. Cent.

This load in 1900, when 2.641 was running her trials as a new exhibition engine, was only once exceeded on the Nord Express, and without a steam-heated train, as it was in the early autumn.

On the Lille section, on the 10.15 Rapide, engine 3.1166 and a load of eight bogies, or 300 tons, in spite of wind and rain, made a fine run, passing St. Denis, 4.31 miles, in 5 min. 35 sec.; Survilliers, 18.6 miles, in 20 min. 10 sec., the minimum speed being 55.9 m.p.h.; Chantilly, 25.4 miles, in 27 min. 35 sec.; Creil, 31.7 miles, in 32 min. 25 sec., at reduced speed; Clermont, 41 miles, in 42 min. 25 sec.; St. Just, 49.8 miles, in 51 min. 20 sec.; Gannes, 54.7 miles, in 56 min. 20 sec., at a minimum speed of 57.7 m.p.h.; Breteuil, 59 miles, in 60 min. 35 sec.; and after a permanent way slow for 2 min. 10 sec., 71 min. from the start, passed Longueau, 78.2 miles, dead slow, in 81 min. 55 sec. After Longueau we were stopped for 45 sec.; but, including this, passed Corbie, 86.9 miles, in 94 min. 10 sec.; Albert, 96.8 miles, in 103 min. 25 sec.; Achiet, 107.9 miles, in 114 min. 35 sec.; and stopped in Arras, 119.7 miles, in 124 min. 25 sec. gross, one and a-half minute early. Our net time was 120 min. 25 sec., without ever exceeding a maximum speed of 68.3 m.p.h. From Arras we passed Vitry, 9.3 miles, in 11 min. 5 sec.; and stopped in Douai, 15.5 miles, in 18 min. 25 sec. From there we passed Leforest, 4.3 miles, in 7 min. 45 sec., in spite of a long relaying slow; Phalempin, 11.2 miles, in 15 min. 15 sec.; Petit Ronchin, 18 miles, in 21 min. 30 sec.; and stopped in Lille, 20.4 miles, after an easy approach, in 26 min. 15 sec. gross, or 24 min. 30 sec. net, our total net running time from Paris having been 163 min. 20 sec. On the up journey to Paris on the 4.25 p.m. Rapide, with the same load and engine 3.1161, we ran easily to Douai, 20.4 miles, which was reached in 25 min. 45 sec., with a slow, or 24 min. 30 sec. net, our maximum speed being 68.3 m.p.h.; Douai to Arras, 15.5 miles, took 18 min. 30 sec., with a minimum speed of 60.9 m.p.h.

After Arras the really hard run began, as the up trains have, after Albert, a speed reduction, 6 miles at 50 m.p.h., with a slow, and another long slow at Longueau. We started smartly. One thousand two hundred yards from the start our speed had risen to 45.8 m.p.h.; Boisleux, 5.5 miles, was passed in 7 min. 45 sec., and at the summit our speed was still no lower than 65.2 m.p.h., with pressures of 210 lb. and 30 lb. in the high-pressure and low-pressure cylinders and the pyrometer marking 305 deg. Cent.; Albert, 22.9 miles, in 22 min. 20 sec.; then the easy and a slow to 18 m.p.h.; Corbie, 32.9 miles, in 36 min. 55 sec.; Longueau, 41.5 miles, at 34 m.p.h. after a long slow, in 45 min. 50 sec.; Boves, 43.9 miles, in 49 min. 20 sec.; Ailly, 50.1 miles, in 56 min. 5 sec.; Breteuil, 60.7 miles, in 65 min. 50 sec.; Gannes, 65.1 miles, in 70 min. 25 sec.; St. Just, 69.9 miles, in 74 min. 45 sec.; Clermont, 78.7 miles, in 82 min. 20 sec.; and with a slow before Creil for signals, that station, 88 miles, was passed at 20 m.p.h. in 92 min. 35 sec.; Chantilly, 94.3 miles, in 99 min. 30 sec.; Survilliers, 101.1 miles, in 107 min. 30 sec.; St. Denis, 115.4 miles, in 120 min. 30 sec.; and Paris Nord, 119.7 miles, was reached one and a-quarter minutes early, after an easy approach, in 126 min. 15 sec. The weather was fine with a strong side gale. From Longueau our speed up to Gannes ranged between 60.8 and 67.1 m.p.h., with an absolute minimum at the summit of 62.1 m.p.h. Before Chantilly we had accelerated to 55.9 m.p.h. prior to a slack to 50 m.p.h., and before Survilliers it had reached the same figure. The boiler pressure was steady at 240 lb. per square inch, and up the bank to Gannes the injector was on continuously. The pyrometer marked 330 deg. Cent. Our net time from Arras to Paris was 116 min. 15 sec.

On another occasion I returned from Lille by the 9.10 morning rapide, travelling in the train. The engine, 2.644, with a load of nine bogies, or 332 tons, in spite of rain and a very strong side gale, made a fine run for an old 4–4–2 engine.

From Lille we passed Petit Ronchin, 2.4 miles, in 6 min. 5 sec.; Pont de la Deule, 18.6 miles, in 22 min.; and stopped in Douai in 24 min. 35 sec. Starting from there we passed Vitry, 6.2 miles, in 9 min.; and stopped in Arras, 15.5 miles, in 19 min. 35 sec., one minute early. From Arras the weather was worse and the gale more severe, while the slipping at the start was bad. We passed Boisleux in 8 min. 35 sec.; Achiet, 11.8 miles, in 15 min.; Albert, in 25 min. 45 sec.; Corbie, in 38 min. 25 sec., after a long easy to 50 m.p.h. and a slow to 18 m.p.h. for two minutes; Longueau, dead slow, in 48 min. 35 sec.; Boves, in 52 min. 40 sec.; Ailly, in 59 min. 55 sec.; Breteuil, in 70 min. 20 sec.; Gannes, in 75 min. 15 sec.; Clermont, in 88 min. 40 sec.; Creil, at 30 m.p.h., in 97 min. 45 sec.; Chantilly, in 105 min.; Survilliers, in 112 min. 55 sec.; St. Denis, in 126 min.; and stopped

* No. II. appeared August 10th.

in Paris Nord, after a slack outside, in 131 min., having only lost three minutes from Arras, or a net time of 126 min. 20 sec., a gain of 1 min. 40 sec. to the engine.

In this case no one was aware that times were being taken, and the regular timekeeping of the Lille rapide is excellent.

The other runs were made on the various boat trains, through the courtesy of the Nord and South-Eastern and Chatham Railway companies. The most remarkable feature from the passengers' point of view is the excellent time kept and the regularity of the running.

I made three trips by the night service from Paris to London. On the French side the stops were numerous, the running sharp and the load heavy, over 400 tons, but in every case time was kept to Calais. The crossing was by a French paddle boat, taking from eighty to eighty-five minutes from berth to berth, except when on one occasion we lay in Dover Harbour, owing to bad weather, before being able to come alongside. In each case the engine on the French side was a 3600, 4–6–0 superheater, and on the English side rebuilt Nos. 489 and 749. Leaving Dover Marine with engine 489 and a load of 9 = 15, we passed Folkestone Junction in 11 min. 40 sec.; Ashford, in 29 min. 20 sec.; Tonbridge Junction, in 54 min. 45 sec.; Sevenoaks, in 70 min. 40 sec.; Orpington, in 81 min. 5 sec., after a signal slow up the bank to Halstead tunnel; Bickley, dead slow, in 85 min. 40 sec.; and stopped in Herne Hill in 97 min. 40 sec., after another slow, on time. With the same load and No. 749, we passed Folkestone Junction in 12 min. 20 sec.; Ashford, where we slacked, in 31 min.; Tonbridge Junction, in 58 min. 20 sec.; Sevenoaks, in 72 min.; Orpington, in 82 min.; Bickley, in 86 min.; and stopped in Herne Hill in 98 min., two and a-half minutes early, after a distant signal "on" at Herne Hill. With the same engine and a load of 10 = 16, and a gale of wind, the day we lay in Dover Harbour, we passed Folkestone Junction in 12 min. 30 sec.; Ashford, in 30 min. 15 sec., slightly slacked; Tonbridge Junction, in 58 min. 40 sec.; Sevenoaks, in 72 min. 50 sec.; Orpington, in 83 min. 15 sec.; Bickley, in 87 min. 15 sec.; and, after a signal slow at Penge, stopped in Herne Hill in 98 min. 5 sec.

On the night service from London, No. 749, with a load of 12 = 21 from Herne Hill, passed Beckenham Junction in 12 min.; in spite of a slow for a bridge just before Bickley, in 17 min.; Knockholt, in 28 min. 10 sec.; Sevenoaks, in 35 min. 10 sec.; Tonbridge Junction, in 43 min. 15 sec.; Ashford, in 71 min. 25 sec.; Folkestone Junction, in 87 min. 25 sec.; and, after a slack for the Warren landslip and an easy approach, stopped in Dover Marine in 97 min. 20 sec., four minutes early.

On another occasion the same engine, with a load of 10 = 18 and a late start, passed Beckenham Junction in 10 min.; Bickley, in 14 min. 35 sec.; Orpington, in 19 min. 20 sec.; Sevenoaks, in 30 min. 20 sec.; Tonbridge Junction, in 39 min.; Ashford, in 68 min. 25 sec.; Folkestone Junction, in 85 min. 50 sec.; and stopped in Dover Marine, in 94 min. 40 sec., two and a-half minutes early. The boats to Boulogne were the turbines, and in each case the time of arrival in Paris was punctual.

On the eleven o'clock from Victoria the engine was No. 497 and the load 10 = 18. Herne Hill was passed in 8 min. 25 sec.; Beckenham Junction, with a slow before for replacing signals, in 17 min. 40 sec.; Bickley Junction, with another slow at Shortlands Junction, in 24 min. 20 sec.; Orpington, in 29 min. 20 sec.; Knockholt, in 34 min.; Sevenoaks, dead slow for signals, in 40 min. 45 sec.; Tonbridge Junction, in 50 min. 35 sec.; Ashford, in 79 min.; Folkestone Junction, in 94 min. 50 sec.; and stopped in Dover Marine, in 103 min. 15 sec., on time, or a net time of 97 min. The boat left at 12.56 and berthed at Calais at 2.5 p.m. On the French side, with engine 3.1160 and a load of eleven coaches, or 346 tons, from Calais Maritime we passed Calais Ville in 3 min. 45 sec.; Caffiers, in 18 min. 45 sec.; on the descent we had a signal slow, but passed Boulogne Tintelleries in 34 min. 45 sec.; Etaples, in 54 min. 55 sec.; Rue, in 71 min. 55 sec.; and stopped in Abbeville, in 85 min. 45 sec. Starting from there we were slowed by signals at Pont Rémy, but passed Longpré in 13 min. 5 sec.; Amiens, at 25 m.p.h., in 32 min. 15 sec.; Boves, in 40 min. 20 sec.; Ailly, in 48 min.; Gannes, in 64 min. 25 sec.; St. Just, in 69 min. 35 sec.; Clermont, in 78 min. 20 sec.; Creil, in 87 min. 30 sec.; Chantilly, in 94 min. 10 sec.; Survilliers, in 103 min.; St. Denis, in 119 min. 10 sec.; and, after an easy approach, stopped in Paris exactly on time, at 6.30 p.m., in 126 min. 20 sec.

On another occasion, by the first portion of the eleven o'clock, which ran by Chatham (there were three trains that day), as it was in January, with a load of 10 = 20 and an engine of the same class, we passed Herne Hill in 9 min. 45 sec.; Bickley, in 23 min. 55 sec.; Sole Street, in 44 min.; Chatham, in 52 min. 35 sec.; Sittingbourne, in 61 min. 10 sec.; Faversham, in 73 min. 50 sec.; Canterbury, in 87 min. 45 sec.; Shepherds Well, in 103 min. 30 sec.; and stopped in Dover Marine, in 112 min. 20 sec., one and a-half minute early. The boat with 500 passengers left at 12.56 and berthed in Calais at 2.9 p.m. From Calais, with engine 3.1161 and a load of twelve coaches, 410 tons, without a vacant seat in the train, we passed Calais Ville, in 3 min. 35 sec.; Caffiers, in 19 min.; Boulogne Tintelleries, in 34 min.; and were stopped by signals just before Pont de Briques for one and a-half minutes, but passed Etaples at reduced speed, in 57 min. 20 sec. inclusive; Rue, in 73 min. 55 sec.; and stopped in Abbeville, in 88 min. 30 sec., or 84 min. 30 sec. net. Starting again, we passed Longpré in 13 min. 20 sec.; Amiens, at 25 m.p.h., in 31 min. 30 sec.; Boves, in 38 min. 25 sec.; Ailly, in 46 min.; Gannes, in 63 min. 5 sec.; St. Just, in 68 min. 20 sec.; Clermont, in 76 min. 20 sec.; Creil, in 84 min. 55 sec.; Chantilly, in 91 min. 40 sec.; Survilliers, in 101 min. 20 sec.; St. Denis, in 115 min. 40 sec.; and stopped in Paris Nord, in 121 min. 30 sec., one and a-half minute late.

On a third run with this service and a load of 11 = 22 of the new corridor stock and two rebuilt engines of the same class, from Victoria we passed Herne Hill in 8 min. 25 sec.; Bickley, in 20 min. 5 sec.; Orpington, in 24 min. 55 sec.; Knockholt, in 29 min. 40 sec.; Sevenoaks, in 36 min.; Tonbridge Junction, in 44 min. 5 sec.; Ashford, in 73 min. 25 sec.; Folkestone Junction, slow, in 91 min.; and, after an easy finish, stopped in Dover Marine, in 101 min., two minutes early. The crossing was well on time and we left Calais with a load of thirteen coaches, 410 tons, and engine 3.999. This engine is the rebuilt 4–4–2, No. 2.741, with the water-tube fire-box, as a 4–6–0 with 6ft. 8in. wheels and standard type fire-box and boiler, with a superheater. We passed Calais Ville in 4 min. 5 sec.; Caffiers, in 19 min. 55 sec.; Boulogne Tintelleries, where we eased, in 36 min. 45 sec.; and, approaching Etaples, stood for three and a-half minutes for signals, but we passed Etaples in 61 min. 25 sec. inclusive; Rue, in 77 min. 50 sec.; and stopped in Abbeville, in 93 min. 15 sec., or 88 min. net. From there we passed Longpré in 13 min. 20 sec.; but we slowed after Hangest for three minutes for permanent way repairs, and passed Amiens in 35 min. 5 sec., at 25 m.p.h.; Boves, in 41 min. 50 sec.; Ailly, in 49 min. 25 sec.; Gannes, in 66 min. 25 sec.; St. Just, in 71 min. 25 sec.; Clermont, in 79 min. 25 sec.; Creil, in 88 min. 40 sec.; Chantilly, in 95 min. 50 sec.; Survilliers, in 105 min.; St. Denis, in 119 min. 10 sec.; and stopped in Paris Nord in 124 min. 15 sec.—fine work for the load and a 4–6–0 engine.

On December 20th I took the 2 p.m. from Victoria, which was running in four portions, the first two by Chatham, the third and fourth by Tonbridge. Unfortunately, I did not know this, and went by the second portion, leaving at 1.42, and was constantly checked by the first portion; but engine 489, a rebuild, and a load of 10 = 20, from passing Chatham, dead slow, passed Sittingbourne in 13 min. 55 sec.; Faversham, in 20 min. 50 sec.; Canterbury, in 34 min. 20 sec., having eased for the curve; Shepherds Well, in 49 min. 5 sec.; and stopped in Dover Marine, in 58 min. 30 sec. There was a bad gale in the Channel, and the Pas de Calais, leaving at 4.15, berthed at Calais at 5.42, with over 500 passengers.

From Calais we had engine 3.1162 and a load of ten coaches, or 312 tons. We left twenty-five minutes late and passed Calais Ville in 4 min. 20 sec.; Caffiers, in 19 min. 10 sec.; and stopped in Boulogne Tintelleries, in 35 min. Starting from there, we passed Etaples in 20 min. 45 sec., and stopped in Abbeville in 52 min. 20 sec., after a slow approach. From there we passed Longpré in 13 min. 40 sec., in spite of bad slipping at the start; Amiens, in 31 min. 5 sec., at under 25 m.p.h.; Boves, in 38 min. 50 sec.; Ailly, in 46 min. 20 sec.; Gannes, in 62 min. 55 sec.; St. Just, in 68 min.; Clermont, in 75 min. 35 sec.; Creil, after a very easy approach, in 84 min. 40 sec.; Chantilly, in 91 min. 45 sec.; Survilliers, in 100 min. 30 sec.; St. Denis, in 114 min. 40 sec.; and stopped in Paris Nord, in 120 min. 40 sec., after another easy stop, nineteen minutes late, having made up eight minutes from Calais. Perhaps before the war more would have been made up.

On the Paris-London service I made a run with the 3.45 p.m., with engine No. 3.1168 and a load of eleven coaches, 396 tons. We passed St. Denis in 6 min.; Survilliers, in 23 min.; Chantilly, in 29 min. 15 sec.; Creil, at 50 m.p.h., in 34 min. 30 sec.; Clermont, in 44 min. 25 sec.; St. Just, in 54 min.; Gannes, in 59 min. 30 sec.; but just after had a permanent way slow which delayed us three and a-half minutes. However, we passed Ailly in 75 min. 35 sec. inclusive; Longueau, in 84 min.; Amiens, at 25 m.p.h., after a very smart slow, in 87 min. 30 sec.; Longpré, in 105 min. 35 sec.; and stopped in Abbeville, in 116 min. 50 sec., or 115 min. 20 sec. net. From there we passed Noyelles in 11 min. 35 sec.; Rang-du-Fliers-Verton, in 27 min. 25 sec.; and stopped in Etaples, in 33 min. 40 sec. Slipping spoilt the run on to Boulogne.

The boat left at 7.17 and berthed at Folkestone at 8.50. From there we had a load of 10 = 18 and engine No. 67, a rebuild. From Folkestone Junction siding we passed Folkestone Junction in 1 min.; Sandling Junction, in 10 min. 15 sec.; Ashford, in 20 min. 15 sec.; Tonbridge Junction, in 47 min. 5 sec.; Sevenoaks, in 60 min. 10 sec., a smart climb; Bickley, in 75 min.; Herne Hill, in 85 min. 5 sec.; and stopped in Victoria, in 92 min. 15 sec., only four and a-half minutes late.

On the midday service from Paris I took the 11.52 through train from the Riviera, with a load of ten coaches, or 361 tons, and engine 2.669, on December 8th, the day the French Prime Minister came to London. From the start we passed St. Denis in 6 min. 50 sec., but the Luxe in front slacked us at kilometre post 13; we passed Survilliers, in 24 min. 40 sec.; Chantilly, in 31 min. 45 sec.; Creil, in 36 min. 10 sec.; Clermont, in 46 min. 10 sec.; St. Just, where we were again slacked, in 56 min. 15 sec.; Gannes, after another slight signal slack, in 62 min. 30 sec.; Ailly, after a long slow for relaying, in 81 min.; Longueau, in 89 min. 30 sec.; and stopped in Amiens, in 93 min. 5 sec., or 87 min. 5 sec. net, a gain of one minute on booked time; to avoid delaying the noon train it passed us in Amiens Station. Starting again, we passed St. Roch, in 3 min. 30 sec.; Longpré, in 19 min. 30 sec.; at Pont Remy slowed for signals, and after an easy approach stopped in Abbeville for signals, in 32 min. Starting again, after standing for three and a-quarter minutes, we passed Noyelles, in 11 min. 30 sec.; with another signal slow before Quend Fort Mahon, Etaples, in 35 min. 30 sec.; Boulogne Tintelleries, in 54 min. 50 sec.; Marquise Rinxent, in 67 min.; Caffiers, in 74 min. 55 sec.; and, after again being checked by signals, passed Calais Ville, in 86 min. 15 sec.; and stopped on Calais Pier, in 89 min. 45 sec., or 86 min. 15 sec. net, a total running time from Paris to Calais of 203 min. 50 sec., a gain on booked time of 9 min. 10 sec.

The boat left at 4 p.m. sharp to time and berthed at Dover at 5.10. The second portion had engine No. 507, a rebuild, and a load of 9 = 18, all new corridor stock. We passed Folkestone Junction, in 13 min. 20 sec.; Ashford, in 42 min. 30 sec.; Tonbridge Junction, in 59 min. 30 sec.; Sevenoaks, in 75 min.; Bickley, in 92 min. 5 sec.; Herne Hill, in 103 min. 5 sec., in spite of a signal slack at Dulwich; and stopped in Victoria, in 109 min. 40 sec., only five minutes late; but this is accounted for by the bad slipping, especially climbing to Sevenoaks and in the tunnel, while a special was run into Victoria from Herne Hill for the French Premier.

These cross-Channel runs show that time is kept with regularity, and even when late, the timekeeping is much better than before the war. In no case was any notice given of my travelling.

No doubt when the Nord is completely relaid and the new "Pacifics" are all working pre-war timings will be reintroduced. While on the English side the rebuilt South-Eastern and Chatham engines make up time even with considerable loads. Superheating has no doubt helped to this result.

I must thank the various Ingénieurs en Chef (Materiel et Traction) of the French railways and the South-Eastern and Chatham Continental Manager respectively for the facilities they have granted me to make these observations, which show a high standard of performance and an exceedingly high standard of time-keeping.

PRODUCTION OF IRON AND STEEL IN FRANCE.

According to statistics published by the Comité des Forges, the number of blast-furnaces alight in France on July 1st was 106, against 99 on June 1st, 88 on May 1st, 77 on April 1st, 90 on February 1st, and 116 on January 1st. The number of blast-furnaces ready to work was 64, while those under construction or reconditioning numbered 48. Out of the 71 blast-furnaces in the East and in Alsace-Lorraine in operation on July 1st—as compared with 66 on June 1st—some were working at reduced rates.

In the whole country 7 blast-furnaces were relighted during the month of June, of which three were in the East, two in Alsace-Lorraine, one in the South-west and one in the West; thus the total of furnaces remaining damped down owing to the lack of coke was, at the time the statistics were issued, only 10 compared with the number alight on January 1st.

The production of pig iron during June was 447,013 tons, or an increase of 53,585 tons on the production of the preceding month, and a decrease of 66,275 tons compared with December, the last normal producing month.

The production of steel showed an increase of 39,151 tons compared with May, reaching in June a total of 427,000 tons, a figure which also exceeds—by 12,803 tons—the production of December, 1922. As regards the quantities of steel produced, the June result is the highest recorded since last October. This shows what had been accomplished in all the French iron and steel regions, the large deficit in the Lorraine production having been more than made up.

Lorraine's share in the total production of the country was as follows:—Pig iron, 152,088 tons, against 133,785 in May and 219,137 in December; steel, 139,689 tons, against 112,125 in May and 147,914 in December.

It is clear, therefore, from all the above figures that the production of iron and steel, especially of steel, during June represents a remarkable improvement. Comparing the June production with that of January and December, the June figures show a decrease of 8 per cent. and 12 per cent. respectively, while the corresponding percentages in the case of steel show increases of 4·8 per cent. and 2·4 per cent. respectively.

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Les Isotopes. By A. Damiens. Paris: Gauthier-Villars et Cie., 55, Quai des Grands-Augustins. Price 12*f*.

A Dictionary of Applied Physics, Vol. V., Aeronautics—Metallurgy. Edited by Sir Richard Glazebrook, F.R.S. London: Macmillan and Co., Limited, St. Martin's-street, W.C. 2. Price £3 3s. net.

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Seaplane Hangar at Copenhagen.

In the summer of 1920 the Danish Admiralty decided on a programme for the strengthening of the air defences of the naval base of Copenhagen. The programme included the increasing of the air fleet by a certain number of large fighting and scouting machines of British manufacture, and the enlargement of the existing military aerodromes, including hangar accommodation for the new and a number of the old machines, the existing hangars being too small, and some of them of a temporary character only.

The design and construction of the new hangar was put into the hands of the firm Saxild and Partners by the Civil Engineer-in-Chief of the Admiralty, it being understood that the building should be of a permanent character, and that the main supporting structure should be built in reinforced concrete. Furthermore, it was specified that it should give accommodation for a certain number of large and small craft of given dimensions, and that only a few supports for the roof could be allowed in the hangar in order to leave the floor as clear as possible. The number and dimensions of the different fighting machines to be accommodated were specified as well.

Several different schemes were worked out on the lines laid down, all including a number of intermediate supports for the roof; but it was soon clear to the Admiralty flying experts that the only satisfactory solution of the problem was a design with a free spanning roof without interior supports which would leave the area clear, so as to give a free hand as to the placing and arrangement of the machines. Another consideration which pointed to the necessity for adopting this solution, was that the future dimensions of the machines might increase considerably, and that the hangar might then become useless for machines larger than those for which it was designed. The design described in the following article was consequently worked out and approved by all parties concerned, and the firm received instructions to put the work in hand in September, 1920.

The design finally adopted was for a structure, the principal supporting members of which are parabolic-shaped reinforced concrete arches, founded on reinforced concrete piles, the arches having a theoretical span of 158ft. and a clear span of 140ft. Fig. 5 and Fig. 2, page 176, show, respectively, outside and inside views of the complete structure. The arches, of which there are six spaced at 21ft. 10in. apart from centre to centre, are connected together by longitudinal reinforced concrete beams, shown in Fig. 1, page 176. The roof itself is made of 1¼in. boards laid on 8in. by 8in. timber, bolted on the outside of the main arches. At one end the hangar is closed by a wall of timber and boards in which very big windows are provided, this wall being only temporary, as an enlargement of the structure is contemplated. At the front end of the building a reinforced concrete gantry is provided for guiding big steel doors which run on a rail at ground level, and are held vertical by other rails fixed above.

The total span of the building is slightly reduced internally by brick walls at both sides of the hangar, outside which and between the end abutment of the arches, repair shops, bathrooms, canteens, &c., are arranged. Two travelling cranes, each of 3 tons capacity, run under two of the longitudinal beams, so as to enable the heavy engines to be easily lifted out of the seaplanes and taken to the workshops on trucks. The floor is paved with 6in. mass concrete flooring, as also are the space in front of the hangar and a wide road down to the shore, expansion joints having been provided at intervals to avoid cracks. The building is lighted by day by the large windows in the end wall and by night by six powerful electric lamps suspended from the roof.

Any structure of this nature and exceptional size should, obviously, be very carefully designed, and care was, in this particular case, all the more necessary because the conditions under which the building had to be erected were most unfavourable. The ground on which the building was to be put up consisted of old filling, which necessitated the provision of pile foundations under the whole structure. Furthermore, the position of the building was very exposed, being subject during the winter to heavy gales from north and east.

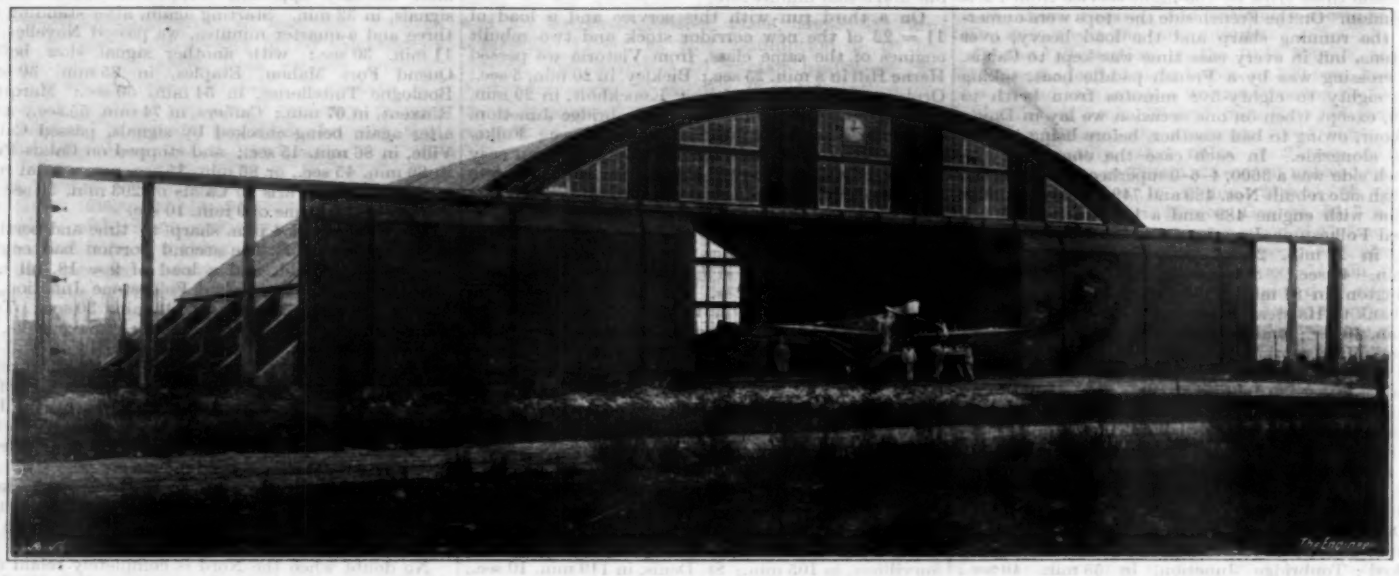


FIG. 5—GENERAL VIEW OF THE COMPLETED HANGAR

The following data, on which the design was got out, may be given:—

(1) The permissible stress for concrete under compression was fixed at 640 lb. per square inch, while the tensional stress in steel was limited to 17,000 lb. per square inch.

(2) The loads for which the structure has been designed are the following:—(*a*) The deadweight of the close-boarded roof decking covered with felt and carried by timber purlins supported on the arched trusses; (*b*) the deadweight of the arch, which varies with the cross-section and slope; (*c*) the concrete purlins and bracings, the weight of which was taken as being distributed evenly over the span

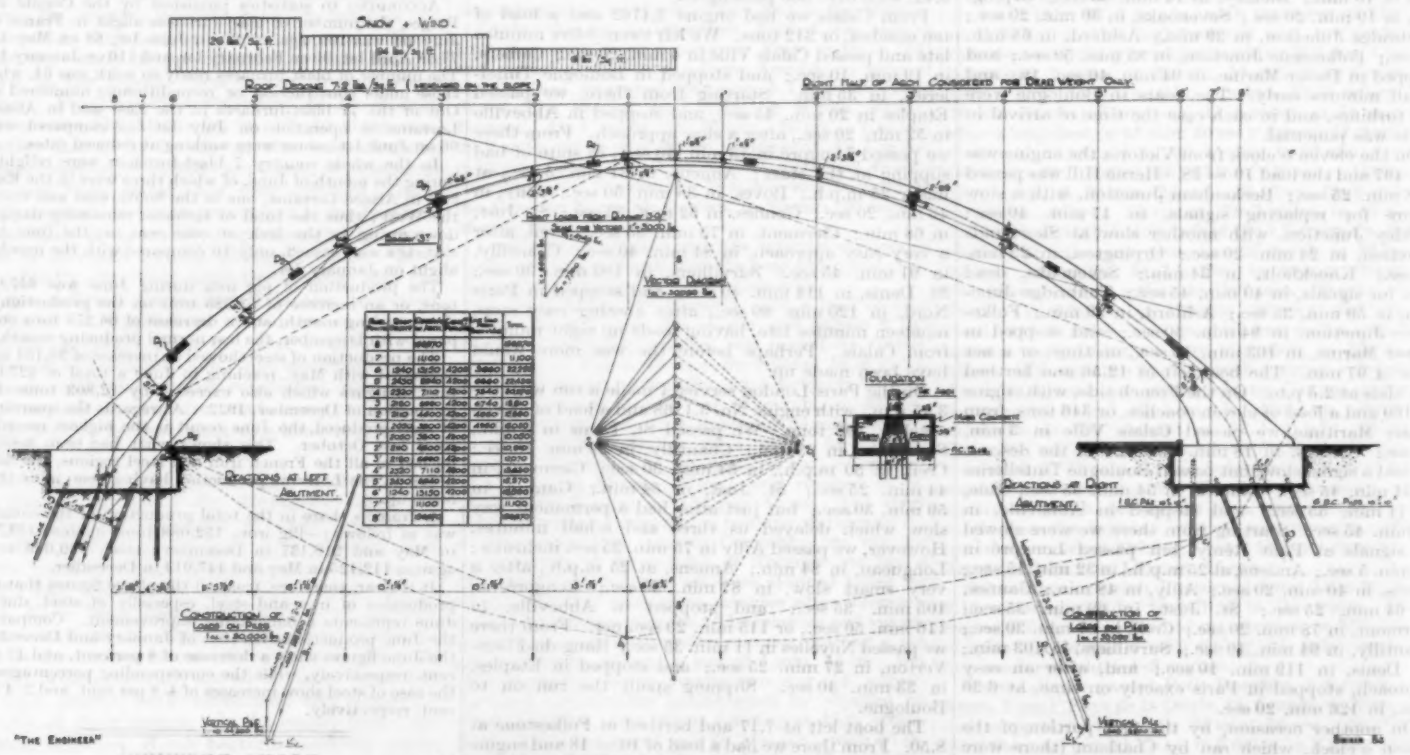

SNOW + WIND.
ROOF DECKING 7·2 lbs/sq.ft. (MEASURED ON THE SLOPE)
RIGHT HALF OF ARCH CONSIDERED FOR DEAD WEIGHT ONLY
REACTIONS AT LEFT ABUTMENT
REACTIONS AT RIGHT ABUTMENT
CONSTRUCTION OF LOADS ON PILES
VERTICAL PILE
FOUNDATION
MAIN CONCRETE
"THE ENGINEER"

FIG. 6—DIAGRAM SHOWING EFFECTS OF LOADS ON ARCH RIB

of the arch; (*d*) the live load due to snow and wind which was taken as a vertically distributed load of an intensity as specified in the Danish Building Code of 1916 and varying with the slope of the roof; and finally (*e*) an additional load imposed at points D 3—Fig. 6—by a runway for a 3-ton crane. The effects of all the loads are shown diagrammatically in Fig. 6.

The arch is restrained at the skewbacks and is fixed into the heavy abutments. Consequently, the structure is three times statically indeterminate, and the exact computation of bending moments, shearing forces and normal forces (thrust), can be arrived at only by considering the deflections. In this case, however, a satisfactory result was obtained by setting out the line of thrust as a funicular polygon to the acting external forces. By means of a series of trials it was ascertained that the most advantageous direction of the line of thrust passed through the points *a*, *b* and *c*, and the funicular polygon of the acting forces passing through those points was set out by the well-known method of drawing the vector diagram of the forces and constructing a preliminary corresponding link polygon—shown dotted in Fig. 2—and utilising the humology existing between this link polygon and the required one through points *a*, *b* and *c*. In this case, in which all forces are vertical, the construction was especially simple.

The stresses introduced by the point loads at the panel points D 3 were found separately in a similar manner, as those loads may not always act in conjunction with the superimposed load from snow and wind.

The normal force (thrust) in any section of the arch is represented by a ray in the vector diagram, where it can be measured. The excentricity is measured in the drawing as the distance from the link polygon to the arch centre line and the bending moment on the section is derived therefrom.

The results arrived at are set out in the tables below:—

Moments and Normal Forces from Dead Weight, Plus Wind and Snow.

Point.	Moment. Foot-pounds.	Normal forces. Lb.
6	− 258,000	143,000
5	− 121,000	123,000
4	− 38,000	115,000
3	+ 34,000	102,000
2	+ 41,000	96,000
1	+ 36,000	91,000
1	− 15,000	91,000
2	− 33,000	93,000
3	− 29,000	98,000
4	− 21,000	105,000
5	+ 86,000	113,000
6	+ 246,000	125,000

Moments and Normal Forces from Point Load from Crane Girder.

6	− 49,000	7,700
5	− 33,000	7,300
4	0	6,800
3	+ 47,000	6,300
2	+ 12,000	4,400
1	− 13,000	4,600
1	− 26,000	4,600
2	− 33,000	4,700
3	− 32,000	4,700
4	− 20,000	4,600
5	+ 7,000	4,400
6	+ 4,500	4,000

Resulting Maximum Moments and Normal Forces.

6	− 307,000	157,000
5	− 154,000	130,000
4	− 38,000	122,000
3	+ 81,000	108,000
2	+ 53,000	100,000
1	+ 36,000	96,000
1	− 41,000	96,000
2	− 66,000	98,000
3	− 61,000	103,000
4	− 41,000	110,000
5	+ 93,000	118,000
6	+ 291,000	129,000

As the live load might be imposed on either the left or the right-hand side of the arch, all the sections were considered for positive as well as negative moments of the same magnitude. The normal forces will always be thrusts, and the stresses in the various sections were derived from the above. The table below gives details of the reinforcements employed and of the stresses induced.

Point.	Maximum moment.	Thrust.	Sectional area, depth × width.	Steel provided in top and bottom in per cent. of sectional area.	Stress in concrete.	Stress in steel.
	Foot-pounds.	Lb.			Lb. per sq. in.	T. T.
1	41,000	96,000	1ft. 11½in. × 12in.	1.05	548	389 7550 (Compression)
2	66,000	100,000	2ft. 3½in. × 12in.	1.2	531	855 — (Tension)
3	80,000	110,000	2ft. 9½in. × 12in.	1.0	498	398 — (Tension)
4	40,000	122,000	3ft. 3½in. × 12in.	.4	Stresses small	
5	154,000	130,000	3ft. 11½in. × 12in.	.35	590	2,350 —
6	307,000	151,000	4ft. 11½in. × 1ft. 8in.	.15	625	5,690 —

The reactions on the arch may also be ascertained from the above mentioned link polygon—see Fig. 6—and in each case the reaction is split up into two components, one vertical through the vertical piles and one in the direction of the inclined piles.

The latter does not pass through the centroid of the group of piles which, considered as a section, is consequently subject to an excentric force and the loads on the piles will be:—

$$P = \frac{R}{A} \pm \frac{e \times R}{W}$$

Where *e* is the excentricity A is the total area of the pile group and W the sectional modulus for same.

Left-hand side: Inclined piles P_i = + 25.5 tons, + 12.5 „

Inclined piles P_v = + 20 „

Right-hand side: Inclined piles P_i = + 30 „, + 9.6 „

Inclined piles P_v = + 4.4 „

To give extra weight the slab at the abutment is covered up with soil held in position by a small retaining wall, and the slab is designed to carry the corresponding load of 4ft. 9in. of soil to the piles. The abutments are reinforced with closely spaced links and steel bars round the pile links, and the vertical piles are left protruding 3ft. into the abutment so as to anchor it properly as an extra factor of safety, in case, by reason of some extreme loading other than those considered above, the pile should be subject to an actual pull.

When calculating the effects of wind on the structure as apart from its effect on the vertical loads investigated above, the whole structure was considered for wind acting broadside on the gables, and rigidity was obtained by connecting up the six arches forming the main carrying structure by means of longitudinal wind bracings at the points D1, D2, D3, and D4, so that the whole system, consisting of arches and longitudinal girders, is made to form one structure, or "wind girder," with the object of carrying the wind load to the foundations where it ultimately is taken up by the earth pressure on the abutments.

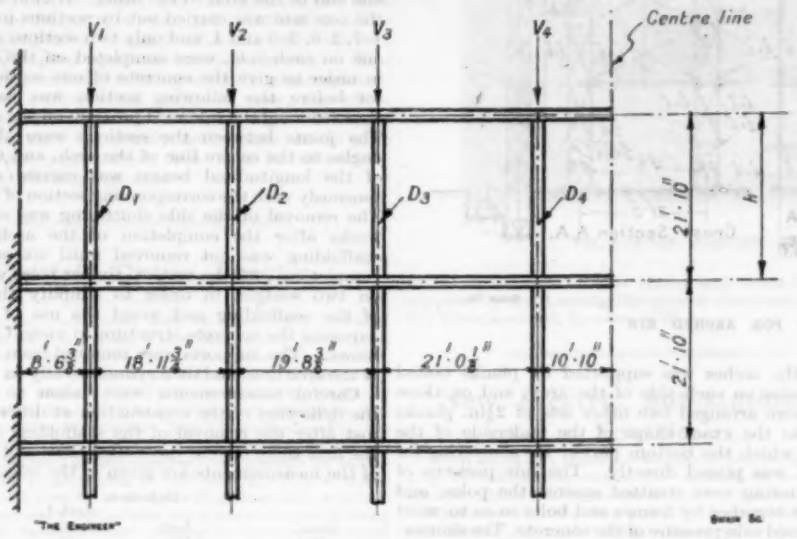


FIG. 7

To form a reasonable idea of the strains and stresses introduced in this way, the horizontal projection of the "wind girder" was considered as a number of "Vierendeel" girders, i.e., girders with stiff corner connections and subjected to the horizontal loads on the gables. Fig. 7 shows a sketch of the girder. As is well known a "Vierendeel" girder is many times statically indeterminate, and while it is quite possible to find by the slope-deflection method the unknown quantities, and thereby the actual moments, &c., in the structure, the large number of unknown quantities makes it a very lengthy operation, and requires all the figures worked out to great exactness in the number of decimal points.

The usual approximation of substituting a certain statically determinate structure has, therefore, been adopted. This system is sketched in Fig. 8, from which it will be seen that the girder is made statically determinate by introducing hinges between the panel points where the shear is maximum and the moments are nil. Using the notation as shown in the figure, we have:—

$$C = T = \frac{M}{h}$$

$$S_1 = S_2 = \tfrac{1}{2} Q$$

where Q is the shearing force and M the bending moment at the point, considering the whole girder. To find the shear H in the struts it must be remembered that the T-shaped member between the hinges must be in equilibrium under the forces acting thereon and introduced by the other parts of the structure, *i.e.*,

$$H = \frac{S_1 a, X \frac{d}{2} + S_1 b X \frac{d}{2}}{\frac{h}{2}} = \frac{d}{h} (S_1, a + S_1, b.)$$

$$= \frac{d}{h} X \frac{(Q\ a + Q, b)}{2}. \quad \text{Hence } \frac{Q a + Q b}{2} \text{ is the}$$

average of the shearing forces at points *a* and *b*.

The forces S_1, S_2, and H give the moments at the stiff corners and the sections are then designed for those moments and the combined thrust C or tension T.

The work was started in September, 1920, and was pushed through and finished in about five working months, operations being suspended some six weeks during the winter owing to bad weather conditions. Before starting pile-driving, the excavation for the foundation blocks was carried out to 5ft. below the ground level. All the piles employed were of reinforced concrete, 10in. by 10in. in cross section, the reinforcement being four longitudinal ¾in. bars connected together with twisted ¼in. bindings.

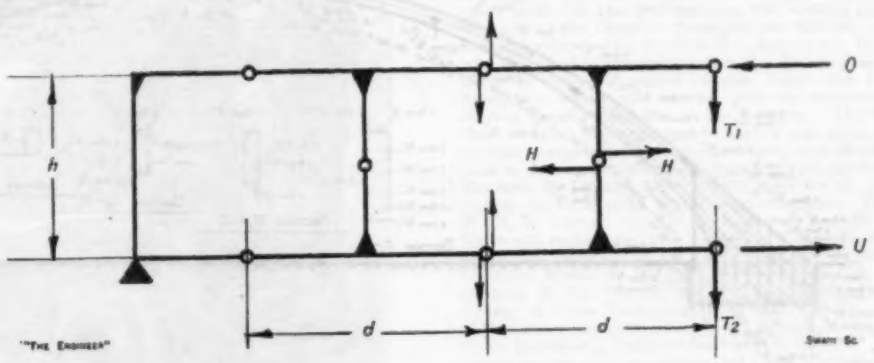


FIG. 8

The ground through which the piles were driven was very difficult. It consisted of old filling, which contained scrap iron, timber, clothes, brick rubbish, &c., and it was very hard to get the piles down through it. In consequence, the driving had to be carried out with the utmost care, in order to prevent the concrete being crushed. As it was of the greatest importance that the piles should be driven through the filling and down to the solid ground, a very heavy

hammer in proportion to the size of the pile was used, but the "drops" did not exceed 20in., with the result that all the piles were successfully driven about 2ft. into the solid ground. To give an idea of the difficulty of driving, it may be mentioned that though the length of the piles was not more than 15ft., the number of blows necessary for the driving of each pile was about 2000, so much care had to be exercised in the process in order to prevent the top end from being crushed. As an additional precaution a cushion of cement sacks was put on top of the pile so that the hammer did not come into direct contact with the concrete. Each arch is founded on fourteen piles, seven at each end, of which six are driven at an inclination of 1 in 2½, and the seventh vertically. The six inclined piles are simply carried about 1ft. into the foundation block without any bonding of the reinforcement, but since, as mentioned above, the vertical pile might, under unfavourable conditions, be subject to tension, the steel reinforcing bars were, in its case, taken up about 3ft. into the foundation block.

After completion of the pile-driving and of the cutting of the piles to the desired lengths, the end abutments of the arches were put in up to a line drawn from the point of intersection between the ground level and the inner side of the arch, and at right angles to the outer side, as can be seen from Fig. 4, page 176.

Owing to the flatness of the arches, the foundation blocks had to be enlarged so as to give an additional perpendicular load on the piles, and thus to render the resulting force on the pile foundations steeper than the angle to which the piles were driven, as mentioned above. It was estimated that this extra load would be provided by the weight of the filling, acting on a reinforced concrete slab made just over the piles, but since the earth filling round the foundations might subsequently be dug out for some reason or other, this arrangement was not thought to be quite safe. Boxes of concrete were, therefore, formed on the foundation slab, and were filled with selected heavy filling, and then covered with concrete paving, as can be seen in Fig. 4, which also shows the end abutments of the arches completed. The foundation slabs were cast on a layer of very soft filling, in order to make certain that the superimposed loads were not carried directly by the ground, but were transferred to the foundations as estimated in the calculations.

The construction of the main arches included the erection of scaffolding to support the shuttering, the putting in of the reinforcement bars, and the placing of the concrete. The heaviest part of this work was the erection of the scaffolding, both for the arches and the longitudinal beams connecting them. As the site on which the hangar was constructed was very exposed to heavy winds, it was judged necessary to make this scaffolding particularly resistant and strong, not only to prevent it from being knocked down by wind pressure, but also to avoid vibrations and movements, especially during the setting and hardening of the concrete.

Fig. 9 shows the arrangement of the scaffolding for the main arches, which consisted of two ranges of 4in. by 4in. timber poles on each side of the arch and 3ft. apart. Fig. 3, page 176, is reproduced from a photograph of the same. The poles for the two ranges were braced horizontally in both directions every 6ft. in height, and the scaffolding for the main arches was connected together by the scaffolding for the longitudinal beams and was also properly braced. The whole of the scaffolding thus had very great strength lengthways of the building. The shuttering for the arches was supported by planks bolted to the poles on each side of the arch, and on these planks were arranged two other sets of 2½in. planks formed to the exact shape of the underside of the arch, on which the bottom part of the shuttering for the arch was placed directly. The side portions of the shuttering were strutted against the poles, and also kept together by frames and bolts so as to resist the outward side-pressure of the concrete. The shuttering for the longitudinal beams was carried out on the same system. The steel reinforcement consisted of ordinary round steel bars provided with hooks at both ends, and as most of the bars were plain, the bending and placing of the reinforcements was a very simple matter. Fig. 10 gives details of the reinforcement in one of the arches. The reinforcement for an arch was not placed until the bottom part of one side of the shuttering was complete, an arrangement which made it an easy job to fix the steel bars properly in position. After that was done, the other side of the scaffolding was erected, so that both the shuttering and the reinforcement were complete before the placing of the concrete was started.

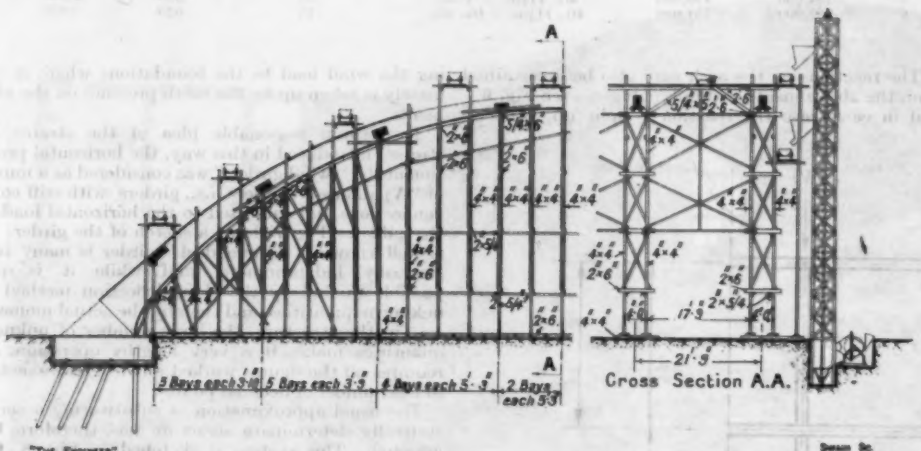


FIG. 9—ARRANGEMENT OF SCAFFOLDING FOR ARCHED RIB

As mentioned above, when discussing the calculations for the arches, it will be seen that the concrete itself was worked up to its limit with the usual factor of safety, so that it was essential that the very best material should be used in order to obtain the best possible concrete, which was a 1 by 2 by 3 mixture, consisting of one part of the best slow-setting Portland cement, to two parts of clean coarse sand, to three parts of washed ¾in. sea shingle. Test beams were cast on an extensive scale, and in no case was the crushing strength found to be below 3000 lb. per square inch. The permissible stress adopted was, it will be remembered, 640 lb. per square inch, so that the minimum factor of safety worked out at just under five.

The use of a chuting plant for the placing of the concrete was contemplated, but not found suitable, chiefly because it was thought that concrete distributed through chutes would necessarily have to have a higher content of water than would concrete distributed by hand, so that the final strength of the concrete would be reduced. Later experience gained by the firm in charge of the work has shown that this fear is unfounded, and that a chuting plant can safely be used for this class of work without the risk of the concrete being of inferior quality, provided, naturally, that the work is carried out with the necessary care and under close supervision, which, by the way, does not only apply to work in which chuting plants are used, but is an essential condition of all successful reinforced concrete work.

The concrete was mixed in an electrically driven tipping mixer, placed on one end of the hangar, and was hoisted into a small timber bunker from which it was distributed, as shown on the drawing, Fig. 9. In order to ensure the symmetrical loading of the scaffolding, and to avoid too heavy pressure on the shuttering, the concreting of the arches was carried out in the following way:—The eight longitudinal beams divide the arches into seven sections of almost equal length. If these sections are numbered from one end of the arch to the other—1, 2, 3, 4, 5, 6, 7—the concrete was carried out by sections in the order 1–7, 2–6, 3–5 and 4, and only two sections of an arch, one on each side, were completed on the same day, in order to give the concrete of one section time to set before the following section was carried out, thus reducing the sideward pressure on the shuttering. The joints between the sections were all at right angles to the centre line of the arch, and the casting of the longitudinal beams was carried out simultaneously with the corresponding section of the arches. The removal of the side shuttering was started two weeks after the completion of the arch, but the scaffolding was not removed until six weeks after completion. All the vertical timber poles were placed on two wedges, in order to simplify the removal of the scaffolding and avoid the use of force and exposing the concrete structure to violent shocks and blows. The supports were removed from the middle of the arch first, and then symmetrically on both sides.

Careful measurements were taken to determine the deflection of the construction at different points, just after the removal of the scaffolding and during the first three or four days after that, and the results of the measurements are given in the schedule below.

Deflection.

Date.	Left.	Centre.	Right.
Arch 1.			
23/4	Nil	¼in.	Nil
25/4	Nil	¼in.	Nil
27/4	Nil	¼in.	Nil
Arch 2.			
23/4	Nil	Nil	Nil
25/4	¼in.	¼in.	Nil
27/4	¼in.	¼in.	Nil
28/4	¼in.	¼in.	Nil
Arch 3.			
28/3	Nil	Nil	Nil
29/3	Nil	Nil	Nil
30/3	Nil	¼in.	Nil
Arch 4.			
3/5	Nil	Nil	Nil
4/5	Nil	¼in.	Nil
5/6	Nil	¼in.	Nil
Arch 5.			
3/5	Nil	Nil	Nil
4/5	¼in.	¼in.	Nil
6/5	¼in.	¼in.	Nil

The deflection was measured in the middle of the arches and at two points about 35ft. to both sides. The outstanding feature of the measurements was that the deflection was greatest in the middle and almost insignificant at the two side points. Furthermore, it will be seen that the deflection in the middle of the arch continued for the first three or four days, while the deflection at the two side points did not increase, which shows that the deflection was not due to any setting of the foundations, since that would have affected all points in the same proportion, but must be due to the elastic deformation of the arch. The total deflection at the centre of the

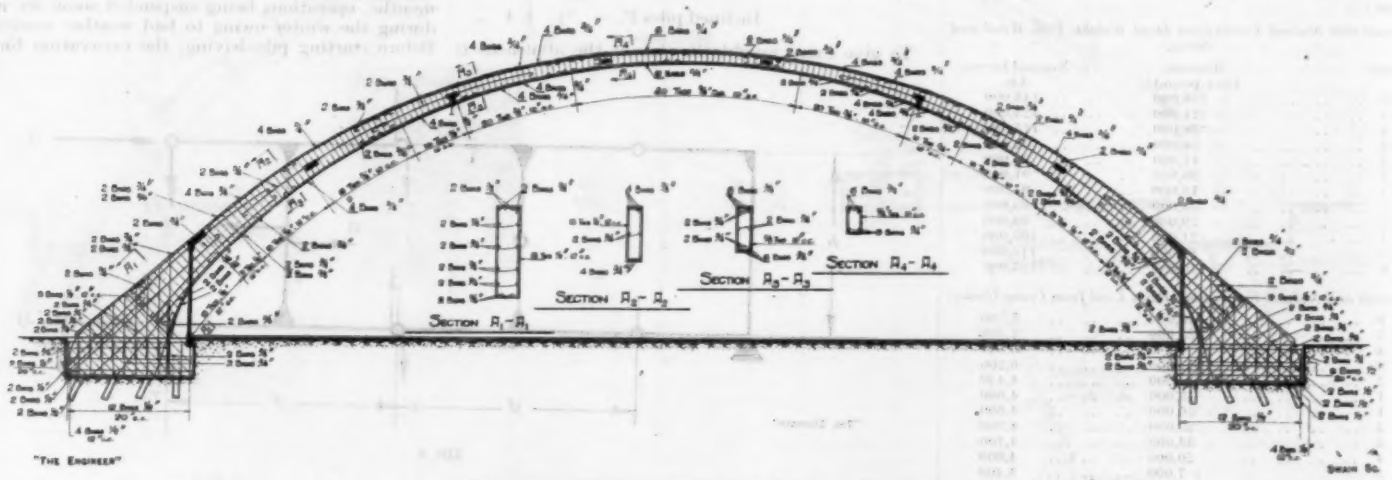


FIG. 10—REINFORCEMENT OF ONE OF THE ARCHED RIBS

arch varied from ¼in. to ¾in., which, in proportion to the span of 158ft., must be regarded as very small.

The 8in. by 8in. timbers which support the roof were fixed to the concrete structure by 1in. galvanised bolts fixed in the arches. On top of these timbers close-boarding 1in. thick was nailed, and covered with roofing felt, which has proved a very suitable and water-tight covering.

It was originally intended to build the gantry supporting the end doors in timber, but finally reinforced concrete was adopted owing to its greater rigidity and strength, and seeing that the doors had to be made considerably heavier than was originally proposed. The gantry consists of columns, founded on reinforced concrete piles, which are driven at an incline in order to take the lateral forces due to wind pressure on the doors when open, and of two beams, one below ground level, and one on top of the columns. The weight of the doors is carried by the lower beam, on which is bolted a rail on which the doors run on wheels provided with ball bearings, while the upper beam carries two rails between which the doors travel. The doors themselves are made of steel frames, covered with corrugated steel sheeting, and they are moved by hand winches which operate direct on the wheels at the base of the doors; but this method has been found to be rather slow, and it is realised that the winches ought to have been fitted with electric motors, which would speed up operations considerably. This alteration is, we believe, being actually contemplated.

From an architectural point of view, the effect of the complete structure is considerable. It might be thought that the purely arch shape would give an awkward appearance, but this is effectively checked by the huge gantry.

Electric Crane Trucks.

THE electric truck fitted with an electrically operated jib crane is not, of course, a new idea, but the merits of this type of vehicle are perhaps none too well recognised. Its ability to pick up loads as well as to transport them from place to place is often a great advantage in works where castings, &c., have to be placed on machines, and in warehouses, and so forth. The illustrations—Fig. 1—show a 1-ton crane having a semi-automatic luffing jib fitted to a 2½-ton Lansing electric truck; which by reason of its robust construction is well able to carry a crane. The crane is driven by a separate electric motor, which is mounted vertically behind the crane post, the power being transmitted through worm gearing on to a countershaft and then by spur gearing to the winding drum. The control gear is extremely simple and fool proof, one hand wheel controlling the power for raising and lowering and being interconnected with a simple contracting hand brake. An automatic stop cuts off the current when the jib is raised to its maximum height.

Electric power for operating the crane is obtained from the same battery that works the truck, and a neat and accessible switch is provided to change over from the truck motor to the crane and *vice versâ*. The principal dimensions of the crane are as follows:—Maximum height of crane hook from truck platform, 5ft. 3in.; maximum radius of jib, 6ft.; area of platform with crane, 3ft. 7in.

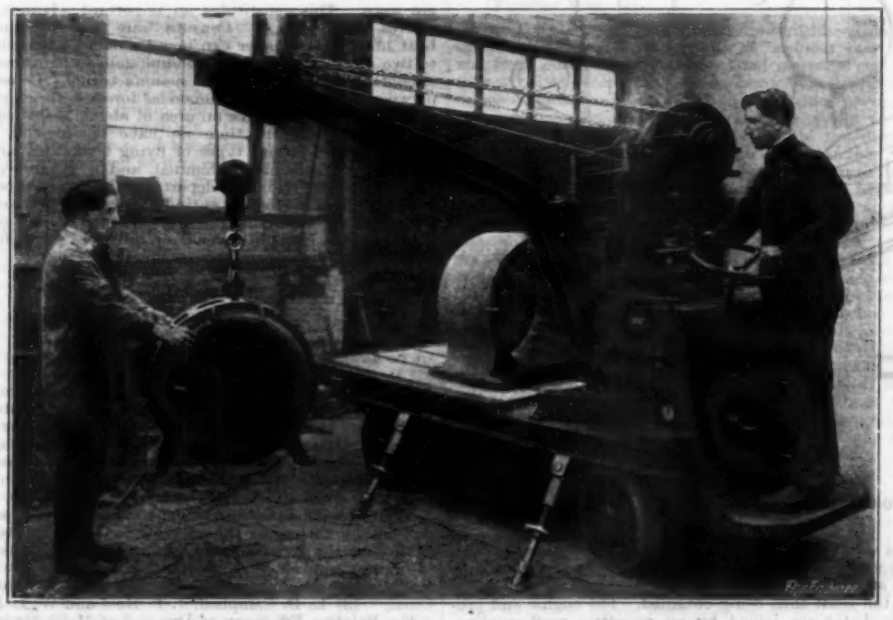


FIG. 1—ELECTRIC RUNABOUT TRUCK WITH SAFETY LEGS LOWERED

by 5ft. 6in.; speed when raising 1 ton, 22ft. per minute. The capacity of the crane without the safety legs down is 8 cwt., and 1 ton when the safety legs are brought into use as shown in Fig. 1. When out of use the safety legs are held up by simple clips. Means are provided for adjusting the length of the legs so as to compensate for any inequalities in the ground surface. The legs are only required when the load exceeds 8 cwt., and the job of putting them into use only occupies a few seconds.

The truck shown in Fig. 2 has an exceptionally large capacity, namely, 3 tons, instead of the standard load of 2½ tons. Like the crane truck it is equipped with twenty-five Ironclad Exide cells. The vehicle is used mainly for travelling between a foundry and a machine shop, which involves running up a gradient of approximately 1 in 20. Before the introduction of the truck the work was done by standard rail trucks, and a considerable amount of shunting had to be carried out before the truck arrived at the machine shop. With the electric truck, however, a casting can be taken from the foundry to its destination in a few minutes. These trucks and crane trucks are supplied by the Lansing Equipment Company, of 96 and 98, Victoria-street, London, S.W. 1.

FIG. 2—3-TON ELECTRIC TRUCK CARRYING LOCOMOTIVE CYLINDER CASTING

New Electric Sub-station for Seattle.

WITH its Skagit River development well under way, the City of Seattle has begun the erection of a large sub-station, which will be known as the north sub-station, and will serve as the receiving point in the city for the energy transmitted from the Skagit River power-house. The new station will be situated in the residential part of the city, and it will eventually contain a maximum of six banks of transformers with the necessary synchronous condensers and switching equipment. The ultimate installation will be fed through two transmission lines of approximately 100 miles in length, designed to transmit 90,000 kilovolt-ampères three-phase 60-cycle current at a received voltage of 154,000 volts. The transformers feeding the lines at the generating station are to be rated at 165,000 volts, and they will have permanently grounded neutrals.

The initial installation will include the equipment for one incoming transmission line at 154,000 volts, one transformer bank, and one 15,000 kilovolt-ampère synchronous condenser. An order for this apparatus has been placed with the Westinghouse Electric and Manufacturing Company, and it is now in course of construction. An electrostatic glow meter will be used for synchronising on the 154,000-volt side. The stepdown transformer bank will have three 10,000 kilovolt-ampère transformers with tertiary windings. Both the 145,000 and 26,000-volt lines are to be connected with permanently grounded neutrals. The 26,000-volt side will be connected to a bus section on which there are three feeders. Ultimately each transformer bank will have a 26,000-volt bus section, and all the sections will be tied together through reactors. At the present time two sections with a total of six feeders will be tied together without reactors and will be fed from one transformer bank. The tertiary windings of the transformers are to be connected in delta at 6300 volts, and are to be connected to the 15,000 kilovolt-ampère synchronous condenser wound for normal operation at 6600 volts. Tappings are to be brought out from the transformer windings for starting the condenser. The high-tension oil circuit breakers are each to have a capacity of 400 ampères at 154,000 volts; the 26,000-volt breakers will each have a capacity of 1200 ampères and will be provided with mufflers; while the breakers for use with the 6600-volt condenser will each have a capacity of 1600 ampères at 25,000 volts.

The auxiliary equipment will consist of a 300 kilovolt-ampère transformer bank; a 100 kilowatt motor generator set to be used for an extra exciter, for operating a crane, or for charging the storage battery in an emergency; a 7½ kilowatt battery charging set; and a 60-cell storage battery for control purposes.

A type D-3 benchboard, having a relay board at its rear, and grill work at each end, will be supplied. This desk will be used for controlling the condenser and the incoming line, and will be drilled for future apparatus for controlling the second line and the tie breaker between the two lines. A switchboard consisting of two switchboards mounted back to back, with grill work between, will be provided for controlling the 26,000-volt feeders and the voltage regulator equipment for the condenser.

There will also be a temperature indicating board for indicating the temperature of the coils in the condensers and the temperatures in the individual transformers; a station service board for controlling the storage battery, station light and power, the spare motor generator set, and other miscellaneous circuits; a field control board, and a crane panel. Differential protection will be provided for the condenser and for the entire transformer bank. The 154,000-volt incoming line will be protected with type CR relays and a ground relay.

SOCIETY OF GLASS TECHNOLOGY.

IN connection with the recent visit of members of the Society of Glass Technology to France, there were meetings with French glass manufacturers and various visits paid. In the first instance, the visiting party was received by the Chambre Syndicale des Maitres Verreries, and was welcomed by its President, Monsieur L. Houdaille, who described to the visitors how the French glass manufacturers were all united in one body—the Chambre Syndicale—which was divided into six sections, representing various branches of the industry. The work of these sections was organised in such a way as to prevent ruinous competition between members, and at the same time to encourage individual research and development. Monsieur L. Delloye spoke of the need for co-operation among manufacturers of different countries. Professor W. E. S. Turner, Colonel S. C. Halse, and Mr. E. A. Hailwood replied for the Society of Glass Technology. Later, the members of the party were the guests of the Chambre Syndicale des Maitres Verreries, and a joint meeting of the Société des Ingénieurs Civils and the Society of Glass Technology was held. In the absence of Monsieur Guillet, President of the Société des Ingénieurs Civils, Monsieur L. Delloye welcomed the visitors. The following papers were communicated:—(1) Professor H. Le Chatelier, "La Méthode Scientifique dans L'Industrie"; (2) Dr. A. Granger, "Les Verres, Opaques et Colorés, et les Glacures Ceramiques de Même Espèce"; (3) Monsieur Laton, "La Dilatation des Verres et Cristaux"; (4) Professor W. E. S. Turner, "Specifications for Glass Products"; (5) Mr. T. Teisen, "Improvements in the Design of Recuperative Glass Pot Furnaces"; and (6) Mr. S. English and Professor W. E. S. Turner, "The Physical Properties of Boric Oxide Glasses."

Visits were paid to the following glass works:—(*a*) Etablissements Legras at St. Denis; (*b*) Verreries de Rheims—Messrs. Charbonneaux and Cie; (*c*) new plate glass works at Chanteresne; (*d*) Glaceries de St. Gobain, Chauny and Ciroy. Members took the opportunity, when at Rheims, of visiting the battlefields in that district. A visit was also paid to the sand quarries at Nemours and to the Forest and Castle of Fontainebleau.

Motor Craft Building at Cowes.

At the beginning of the month we paid a visit to the works of S. E. Saunders, Limited, at East Cowes, and, as might well have been expected, we found the boat-building departments of the firm busily engaged in the completion of various types of motor craft in readiness for Cowes Regatta week. The motor launch is, nowadays, indispensable to the yachtsman, and several of the standard 20ft., 25ft. and 30ft. launches engined with Wolseley motors, were seen in various stages of manufacture. Noteworthy, however, among the other boats was the motor yacht Beryl, which has been built to the order of Lord Inverclyde. She is one of the largest craft of the kind built in Cowes during the year, and some further details concerning her may be given.

The Motor Yacht Beryl.

This vessel was launched on the afternoon of August 2nd, the ceremony being performed by Lady Inverclyde. The illustration given shows her on the launching ways, and serves to indicate her general outline and the character of the deck and navigation accommodation. The vessel is 120ft. long, and has an overall breadth of 18ft. with a draught of 4ft. 9in., whilst her displacement is 65 tons, or 125 tons Thames measurement. The propelling motors are by Beardmore and comprise two six-cylinder units, each designed to develop 90 to 100 brake horse-power at a normal speed of 700 revolutions per minute. The diameter of the cylinders is 142 mm., or nearly 5½in., and the stroke of the engine 175 mm., or about 6⅞in. The units are so rated that a sea speed of about 12¼ knots is obtained at full power. The hull of the yacht is well proportioned, and the framing and internal erections bore evidence of sound workmanship and excellent material. The keel of the yacht is made of oak, and her stem and stern from English elm, while the main frames are of oak and Canadian rock elm. Pitch pine planking of carvel construction is used, and the decks are of teak.

The accommodation provided includes one double state-room with bathroom arranged beneath the forward deck-house, while aft there are four other state-rooms, one of which communicates with a bathroom. There is also a small smoking-room aft, and communication between the forward and aft accommodation is furnished by means of a passage leading through the engine-room. For this reason the machinery is widely spaced with tanks and piping grouped so that a maximum of free space is left in the centre of the engine-room. Electric lighting is fitted, and among other deck machinery we noted an electrically operated anchor capstan. In one of the large shops in which the framing of the yacht was put together in a specially excavated pit prior to the hull being brought forward on to the outer launching ways, we saw in course of construction her motor launch and dinghy. The launch is specially shaped for speed, and is 25ft. in length with a small forward cockpit for the bowman. It is engined with a 23 brake horse-power Sunbeam motor designed to give a speed of about 25 knots. The dinghy has been designed as a class boat for sailing.

Some other Motor Craft.

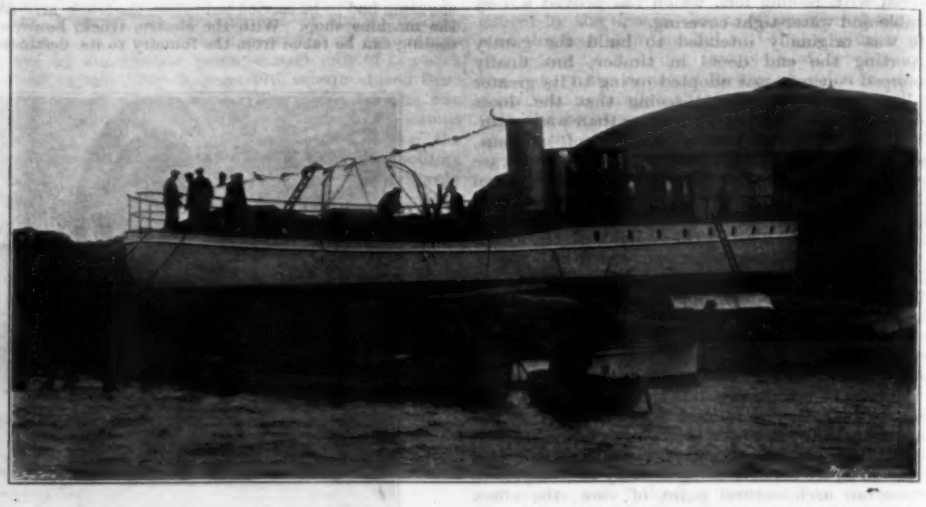
For several years now, S. E. Saunders, Limited, have been contractors to the Royal National Lifeboat Institution, and a number of the Institution's 45ft. lifeboats were seen in various stages of completion. In the shop set apart for fast racing boats, there was the famous motor boat Maple Leaf IV. which, in 1912, brought back from America the International Trophy and successfully defended it again in 1913. At the present time the boat is being re-engined, and with her new twin twelve-cylinder 400 horse-power Liberty motors, which are considerably lighter than those originally installed, it is expected that her previous speed records will be equalled if not surpassed. Another racing boat possessing unusual features was a 21ft. launch fitted with three-litre 75 brake horse-power Wolseley engine. The motor runs at the high speed of 3500 revolutions per minute, and gives to the launch a speed of over 36 knots. A steel propeller of about 13in. diameter with two fine blades is used, and its shaft is supported on the outer side by a swivel joint attached to the rudder post.

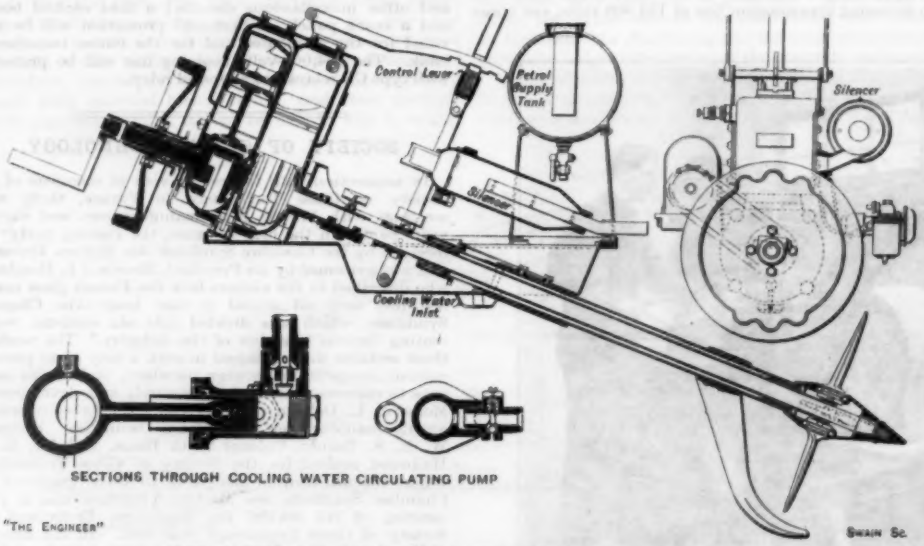
A Detachable Inboard Motor.

Some time ago a small single-cylinder motor boat engine, which aroused favourable comment on account of the novelty of its design, was introduced. This was the Saunders-Clarkson motor, which has now been built in both single and two-cylinder units. A section through the improved two-cylinder type, several examples of which we saw in course of manufacture and assembly, is reproduced below. The inclined engine, with all its accessories, is self-contained on a flat bed-plate carrying the reversible propeller and skeg. This bed-plate can be fitted over a comparatively small aperture cut in the bottom of the boat at the stern, which is subsequently rendered water-tight by a rubber joint. By this means the fitting and lining up of the motor in the boat is reduced to its simplest terms, so that if required the engine can be removed from the boat and replaced without trouble. The motor works on the two-stroke cycle principle, and is designed to develop about 2½ brake horse-power per cylinder at a speed of 1200 revolutions per minute. A monobloc type of cylinder casting is employed, and the tops of the cylinders are furnished with large plugs, which facilitate inspection and cleaning. Both the connecting-rods and the crank shaft are made from carbon steel, and the crank shaft is provided with banjo grooves turned in the webs for lubrication of the crank pins. Forced lubrication is fitted, the pump being driven by the magneto chain. The cranks are balanced, and the crank case, which is gun-metal, is small in size and is designed to fit closely to the webs. This form of crank case is not only light and neat in its construction, but the small clearance confers the advantage of increasing the scavenging effect of the underside of the pistons, and so raising the scavenge air pressure that the exhaust gases may be discharged under water without difficulty. In the making of the engines we noted that the facing on the bed-plate to which the motor is fixed is machined along with the stern tube boss at the same setting, accurate alignment of the engine and tail shaft thus being obtained. The engine and propeller shafts are joined by an excentric muff coupling, from which the cooling water pump, also illustrated in Fig. 2, is driven. The water is taken in through a series of slots in the lowest part of the bed-plate, and passes first to the silencer jacket and then to the cylinders, after which it is discharged through the exhaust pipe jacket. Referring again to the muff coupling, this part, like the fly-wheel, is secured to the shaft by taper cotters in a similar manner to the way in which a bicycle crank is secured to its axle. Apparently, this fastening has proved satisfactory in practice, and for small sizes of shaft it certainly possesses the merit of simplicity. The reversible propeller shown has been the subject of much experimenting, and it is now claimed that a design has been produced which enables reversing to be effected with little effort. The propeller blades are rotated on bronze ball bearings, and the motion is derived from a pin and slot in the usual manner. Bowden wire controls may be fitted for engine throttle control and for the ignition, and the same control plate carries the lever which moves the propeller blades. The system is so balanced that the lever stays in the position in which it is placed, and there is no tendency for the blades to alter that position. The set we have described has many ingenious features, and should prove of interest to boat owners.

THE MOTOR YACHT BERYL

S. E. SAUNDERS, LIMITED, EAST COWES, BUILDERS





SECTIONS THROUGH COOLING WATER CIRCULATING PUMP

"The Engineer" Swain Sc.

THE SAUNDERS-CLARKSON 5-B.H.P. TWO-STROKE INBOARD MOTOR

"Consuta" Sewn Plywood.

"Consuta" sewn plywood was first introduced by Mr. Saunders, about forty years ago, to overcome the difficulties experienced with small craft by the rusting of light steel hulls. In the early design the various plys were sewn together by hand with thin copper wire, and this form of construction is still retained for some kinds of work. Great advances have been made, however, in the processes of sewing, and wood of greater thickness and surface area can now be dealt with. In the plywood supplied during the last few years, prepared linen thread has been used for sewing, and immersion tests have shown the mechanical strength of the linen fibre, which is similar in character to the wood fibre, and remains unaltered by continued immersion in water over long periods. The wood is now sewn on special machines which have been evolved in Saunders' own works. By introducing roller feeds and improved mechanical devices, the speed of sewing has been increased from 300 stitches per minute up to between 700 and 1000 per minute. The largest size of plywood made at present is 50ft. in length and 8ft. wide, and the thickness may be varied from $\frac{1}{16}$in. to $\frac{3}{4}$in. Improvement has also been made in the various types of sewing machines used, and in addition to the horizontal machine for flat sheets, we saw a vertical machine on which hollow formed boat and motor car bodies built in halves are sewn. This constitutes an important advance, for, whereas five pieces of "Consuta" are used for standard boat hulls, this number can now be reduced if desirable to two pieces, with a corresponding gain in lightness and strength. A new factory for manufacturing "Consuta" plywood in its various commercial forms is in course of equipment. It will have an area of about 75,000 square feet. From time to time we have recorded in The Engineer the various types of flying boats and aircraft built by S. E. Saunders, Limited, and it is noteworthy that the aircraft designing department has been reopened, and that designs for an entirely new type of machine are at present occupying the firm's attention. We gather that the intention is to develop aircraft work to the fullest extent, both for land and sea machines.

IRON AND STEEL INSTITUTE.

As previously announced, the autumn meeting of the Iron and Steel Institute will be held at the Chamber of Commerce, Milan (Via Mercanti 2–4), on Monday and Tuesday, September 17th and 18th, commencing at 9.30 a.m. on each day. At the conclusion of the meeting visits have been arranged to Florence, Rome, Piombino, Leghorn, Genoa and Turin.

The following is the list of papers which it is expected will be submitted to the meeting:—(1) C. R. Austin, "Alloys in the Ternary System Iron-Chromium-Carbon;" (2) E. D. Campbell, W. L. Fink and J. F. Ross, "The Iron-Iron Carbide Equilibrium in Dry Hydrogen at 950 deg. Cent.;" (3) E. D. Campbell, J. F. Ross and W. L. Fink, "The Relative Efficiency of Dry and of Moist Hydrogen on the Decarburisation of Steel at 950 deg. Cent., and the Effect of Hydrogen on the Phosphorus Content;" (4) C. A. Edwards and L. B. Pfeil, "A Note on Coarse Corrugation in Mild Steel Sheets;" (5) G. E. Falck, "The Iron and Steel Industry of Italy;" (6) F. Giolliti, "The Complex Action of Manganese and of other So-called Deoxidising Agents in the Manufacture of Steel;" (7) W. T. Griffiths, "The Change Points in some Nickel-Chromium Steels;" (8) W. H. Hatfield, "The Influence of Nickel and Chromium upon the Solubility of Steel (in relation to Corrosion);" (9) Cesare Martelli and Tito Sotgia, "The Iron Ore Mines of Nurra (Sardinia);" (10) A. Portevin, "The Morphology of Pro-eutectoid

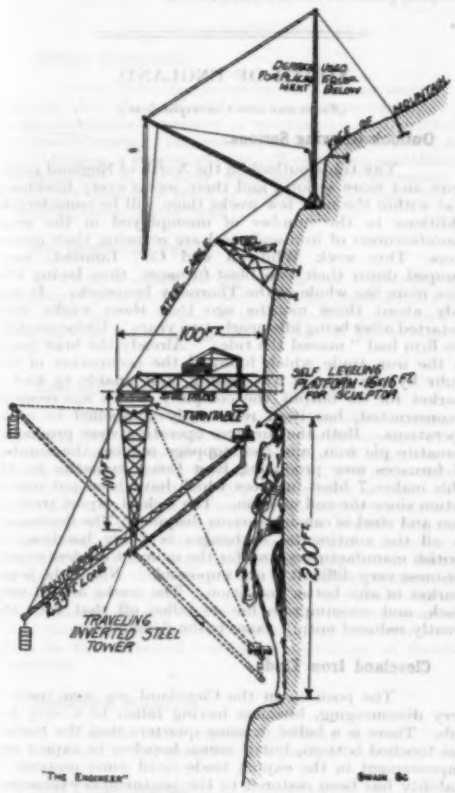
Cementite ; " (11) A. Portevin, " The Corrosion Cracking of Steel under the Influence of Internal Stresses ; " (12) S. H. Rees, " The Effect of Low Temperature Annealing on some Mechanical Properties of Cold-drawn Steels ; " (13) H. Styri, " Theory and Practice of Steel Refining ; " (14) C. Vanzetti, " The Manufacture of Heavy Steel Castings from Small Converters ; " (15) H. C. Wang, " Grain Growth in Iron and Steel."

Steel Pantagraphs, 233ft. Long.

As a memorial of the American Civil War and the former Confederate States, a huge bas relief is to be carved on the face of Stone Mountain, near Atlanta. This mountain is a bare and almost smooth rock mass in shape like an inverted bowl and with precipitous sides. To trace and carve the rock surface from the sculptor's designs there will be immense steel truss pantagraphs, which are described as follows in the *American Manufacturers' Record*, from which also the accompanying illustration is reproduced :—

" In the centre appears a steel truss, 100ft. long, which is anchored on the precipice and at right angles to it, being supported by an immense steel cable, running from the outside end of the truss to a supporting frame, and from thence far up the mountain where it is securely anchored.

" There will be a row of these trusses, extending along



ARRANGEMENT OF PANTAGRAPH

the side of the mountain like brackets on a wall. Along the tops of the trusses will run a track, carrying a travelling crane for the purpose of transporting men and tools, and carrying away stone as it is cut. Along the bottom will run another track, carrying an inverted steel tower 110ft. long. This tower will be mounted on suspension wheels and a turn-table, enabling it to move along the face of the cliff and at the same time swing in any direction.

" At the bottom of this inverted tower will be hinged an immense pantagraph, 233ft. long. On the end of the pantagraph nearest the face of the cliff will be mounted a self-levelling platform, 16ft. square, on which stone cutters will work with pneumatic drills carving the figures. On the other end will be hung a counterweight to balance the load. The pantagraph can be raised or lowered by means of cables running around a drum at the top of the inverted tower. From top to bottom, the pantagraph will have a vertical working radius of 200ft.

" In addition to its vertical and lateral radius, the pantagraph will have a horizontal radius at right angles to the precipice by means of an ingenious turn-table at the top of the inverted tower. On this turn-table the platform can be swung round in a half revolution if necessary, thus drawing it away from the face of the cliff any desired distance.

" These three movements will enable the platform to be shifted in all three directions—up or down, to the right or left, and in or out.

" All operations will be electrical, and one man on the platform will control them with switches. On the platform will be an electrically-driven air compressor, for operating the pneumatic drills.

" This battery of drills, ten or twelve in number, will have a cutting capacity per hour equivalent to a slot 1in. wide, 12in. deep, and 16ft. long."

The holders of what was the preferred ordinary stock in the Great Central have had no dividend since 1889, but have now been paid ½ per cent. by the London and North-Eastern Railway Company.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Hopes for the Autumn.

Iron and steel masters and engineers in the Midlands and Staffordshire are now looking forward to the autumn, when an improvement in business, necessitating greater activity at the works is looked for. For the moment the state of affairs cannot be regarded as anything but unsatisfactory, but there are a few more hopeful signs and a good deal of work is being done in the way of repairs, furnaces being relined, &c., in anticipation of some revival in September. The greater activity of constructional engineers is regarded as a hopeful sign. There are signs, also, that the railways are placing rather more business, demand having improved, among other things, for castings called for as fitments for various kinds of rolling stock. The wagon building firms are among the best customers just now for iron and steel. The sheet trade continues to improve and large orders have been secured by Midland makers who are now sure of employment for some months. Hopes would further revive with a renewal of pig iron buying, but recent demands have been so disappointing and prices so unremunerative that there is further talk of closing down blast-furnaces and placing puddlers on short time. Already there are thousands of tons of iron in stock in this area, and makers cannot afford to continue unless they can find an outlet for their production. The Staffordshire finished iron trade remains very slack, though there is a fair market for bars of best quality. The nut and bolt industry of Darlaston being practically at a standstill, however, has a serious effect upon that portion of the iron trade which caters for nut and bolt quality bars. It is generally acknowledged that the outlook is none too bright, but those inclined to be optimistic, and there is little use in being pessimistic, maintain that there are hopes, if not signs, of an improvement in the autumn.

Large Orders for Galvanised Sheets.

The sheet trade is decidedly the most hopeful of the various branches of the iron and steel trades. The sharp rebound of prices a fortnight ago brought out some very large orders, sufficient to keep the mills employed for some months ahead. Moreover, makers continue to experience a steady flow of orders, and the works in this district are all fairly booked. How many of the orders were speculative ventures by merchants it is difficult to say, but a proportion, at least, can be accounted for in this way. When the productive capacity of the galvanising works is considered, however, the volume of business placed, large as it is, does not seem to have warranted the price fluctuations which took place last month, and which were a feature of the market. There has been no price movement on the week, but late rates are firmly upheld at £18 10s. for the home trade, and £18 15s. to £19 for export f.o.b. An element of firmness has been added through the scarcity of spelter, for which the dock strike, holding up metal at the ports, is partly responsible. It is reported that merchants who bought at cheap rates last month are now reselling material below the present manufacturers' quotations. The improvement in the demand for black sheets, noted last week, continues, and values remain firm. The automobile industry is calling for fairly large tonnages, and orders generally would appear to be on the up-grade.

Finished Iron.

Makers of finished iron in Staffordshire are finding competition for a small volume of business very keen, and their position has been rendered more difficult than it was. The recent advance in ironworkers' wages has imposed limitations to their ability to reduce prices, and an increasing number of the ironworks prefer to keep their plant idle rather than go further in the direction of unprofitable competition. The long-standing basis of £14 10s. for marked bars has undergone no change, and in view of the recent advance of 7½ per cent. in wages, it is likely that this figure will be maintained notwithstanding the unusual disparity between the rates for marked and unmarked qualities. In the present state of depression it is not easy to maintain Crown bars at £12, and some recent sales are reported at £11 15s. Nut and bolt iron is now obtainable in some quarters at £10 17s. 6d., though Lancashire makers refuse to come below £11. The £9 5s. quotation for Belgian nut and bolt iron still holds good, and a few orders have gone in this direction from local users. Iron gas tube strip continues to command from £12 10s. to £12 15s., which compares with about £10 10s. for steel tube strip. Re-rollers are once more competing keenly with the large steel works, taking advantage of the contracts for cheap forging steel made some ago.

Steel Values Firmer.

The practical absence of foreign competition in the steel trade has checked, to some extent, the downward movement in prices. Some of the large steel works have withdrawn quotations for billets under £8, and a number of them demand as much as £8 5s. to £8 7s. 6d. Some buyers of billets have not, for several weeks past, received any continental offers of material, yet there are cases where billets have been bought as low as £7 10s. delivered, and large blooms at slightly over £7. This business, however, is restricted to large consumers regularly taking good tonnages from the Continent, and receiving therefrom a certain amount of preferential treatment. An isolated quotation received from Belgium this week was £7 for billets and £7 2s. 6d. for sheet bars f.o.b. Antwerp. The delivery price in this district would be £8 and £8 2s. 6d., figures which, of course offer no advantage as compared with native material. For finished steel the £9 15s. basis for small bars continues, but the nominal figure of £10 is now more generally insisted upon. Offers of tonnage at lower prices have been refused.

Still Cheaper Pig Iron.

Midland smelters continue to find business very slow, and they are not disposed to entertain the unprofitable prices named by consumers. They have been forced, however, to concede further slight reductions as output greatly exceeds demand, and putting iron into stock is an unprofitable undertaking in these days. Many smelters, however, anticipate better rates when buying is resumed, as they believe it will be in September. Meanwhile, forge material is almost unsaleable, and sales of foundry are on practically a retail scale. Derbyshire No. 3 foundry pig has dropped to round about £4 15s., though £4 17s. 6d. is still quoted, and forge to £4 10s., while Northamptonshire grades fetch £4 15s. for foundry and £4 5s. upwards for forge. There is, however, no standard basis of prices, these being largely a matter of arrangement according to the circumstances at the moment. Smelters still complain of the difficulty in getting coke, large tonnages of which continue to be sent abroad.

Huge Steel Works near Shrewsbury?

It is said that huge steel works are to be opened at Battlefield, near Shrewsbury, in the near future, and also, as an alternative, that works which will have something to do with iron and steel, together with a village for the workers, is contemplated there. There would would appear to be some truth in the rumours, for at a recent meeting of the Atcham (Shrewsbury) Rural District Council, it was reported that the Sanitary Committee had given general approval to plans submitted and that any sewage scheme rendered necessary would be on such a big scale that a special area would be formed. The Clerk intimated that there were prospects of Battlefield becoming a big industrial centre, but the secret of the name of the firm, rumoured to be a North-East Coast one, and the exact nature of the industry, was not divulged. That the scheme may result in nothing is, of course, just possible, and this seems to me more likely than not, since it would seem remarkable that any large iron or steel works should, nowadays, be laid down anywhere except near the coast, certainly not so far inland as Shrewsbury. If, however, the rumours point to a manufacturing establishment where iron and steel is used up, such as an engineering works, railway wagon, commercial motor, or some other venture of this description, then the necessity of being right on the coast does not equally apply. Further information and developments are being awaited with interest.

Engineering.

The engineering and electrical firms in the Midlands are still well employed, and are likely to be so for some time to come. But whilst there is a fair amount of work at the present moment in engineering, orders have not been coming so freely as they did at the beginning of the year. However, business is better than it was at this time last year. More work is being given out to constructional engineers, and there are a good number of inquiries in the market, though the tonnages, invariably, are light, scarcely ever exceeding 200 tons of steel.

LANCASHIRE.

(From our own Correspondents.)

Manchester, Thursday.

General Outlook.

The lack of active interest in the iron and metal trades here is shown by the much smaller attendances at the bi-weekly meetings of the trade on the Manchester Exchange. These attendances have been declining for some time, and are probably now smaller than they have ever been. In such a state of affairs it is only natural that prices should be weak, but as transactions are now mostly on a very small scale the downward movement is slow. The retail character of most of the buying here, together with the high costs of production, delay the return to prices at which it would be possible to expect stability and afterwards an upward movement. In the iron and steel trades we are now missing the influence of a great speculative market which was capable of adjusting prices quickly to the actual conditions of trade.

Metals.

The market for copper has been dull and inactive, and the feeling is certainly not yet very favourable to the future of prices. That this should be so is rather curious, because one cannot see any probability of much lower prices for refined copper than those now prevailing. Best selected ingot copper has been sold lately at £67 10s. per ton, and this is as low as any price during the past twelve months. It is, of course, possible that a further decline may take place, but it can scarcely be very great, and, on the other hand, there is a big margin for an upward movement. This consideration should be an inducement to consumers to hold larger stocks, for the simple reason that appreciation is more probable than depreciation. Nevertheless, the stocks of copper held by the consumer are very far from being large. Probably the very dangerous condition of Germany, both politically and economically is one of the main reasons why people are afraid of copper even at low prices. German consumption is required to maintain the balance between consumption and production, and if Germany is to collapse and to become, in an economical sense, another Russia, it may take a long time to provide some other outlet for the metal which she used to buy. The American domestic demand is also rather unsatisfactory just now, although this may pick up again at any moment. The official price for strong copper sheets was reduced to £98 per ton. The market for the scrap non-ferrous metals is still very feeble. Dealers have made no change in the prices they offer, but as these are so far below intrinsic values, a drop of £1 or so in the prices of new metals has no influence upon them. In the market for tin there has been no very serious change. Fluctuations have been confined within

a few pounds per ton of late, but the statistical position of tin has been improving, and one would not be surprised to see indications of greater confidence before very long. Of course, the general economic condition of the world is against tin, as it is against every other market, and the decrease in the visible supply does not, therefore, have so much effect as it would have in ordinary circumstances. Lead has been rather a dull market, but this is attributed to the holiday period. The return of the dockers to their work will, however, release a fair quantity of metal. The view taken in the spelter market seems to be rather favourable at present. The prices keep steady, and the actual demand from the galvanising trade is rather good.

Pig Iron.

The market for pig iron in Manchester is merely a retail affair now. People take orders for 10 tons, and if they get a few of these they seem to think that business is better; but it is obvious that the weekly consumption of foundry iron in the district must be very low. The price of Derbyshire No. 3 now varies from 92s. 6d. per ton to 95s. per ton on trucks at the furnaces, and this means that the price delivered in Manchester has come down practically to £5 per ton. It was said that at this cost people would begin seriously to buy foundry iron over the rest of the year, but so far, one can see no sign of any such disposition. The buying is now better than it was when Derbyshire iron was 10s. higher, and it is clear that consumers do not believe that prices are safe yet. The margin of profit on the working of the blast-furnaces cannot be great now, if it exists at all, for the price of coke has not fallen, and does not seem very likely to fall, because the export demand is reviving. Probably more furnaces will be damped down and eventually blown out this month; but that is a poor way of keeping up prices, even if it should succeed. East Coast hematite is now very cheap, being offered at 4s. 6d. to 5s. per ton below the price of No. 3 foundry in Cleveland. Delivered here it would cost about 110s. per ton, and is thus considerably cheaper than Scotch foundry iron for the same delivery.

Finished Material.

The market here for manufactured steel does not show much change. The steel sheet makers seem to be fairly well off, but all other departments are dull and the works are short of orders. There has been no open fall in the prices. Merchants still quote £9 10s. per ton for joists and angles, and about £10 for plates, but it is probable that less would be accepted for any good specification.

Scrap.

Dealers in scrap iron and steel remain very dissatisfied with the condition of trade. It is probable that a good deal more scrap is coming into the market than can be absorbed, and although prices are very low this tends towards weakness. Nominally, at the present time, the values of scrap in Lancashire are about £3 15s. for heavy wrought, £3 for melting steel scrap, and £4 to £4 5s. for good to best machinery cast scrap. There is, however, very little actual business passing.

BARROW-IN-FURNESS, Thursday.

Hematite.

The dull period in the hematite pig iron trade continues, and until the market regains confidence we may expect no alteration. The Ruhr trade which once kept us busy has the opposite effect now, and one cannot say how long the present slump may last. Customers are only ordering in small parcels, sufficient to keep them going, and there is very little being done in forward orders—nothing like there was. Trade with the Continent does not bulk largely. There was a dispatch of pig iron to Ghent last week, and the vessel which took it out brought in billets. There are some who hope for better trade with America, and this may develop. Prices are not quite stable, but there is not a great variation. Special qualities of iron are not finding a ready market, but manganese is in fair demand. There is a small trade for charcoal iron, but the output is limited in this class to one small works.

Iron Ore.

The iron ore trade is very quiet, and some mines have closed down—mostly those privately owned. Those owned by iron smelters are very restricted in their output. Despite the slump the Hodbarrow Mining Company is starting some men, but they will only work five days a week. The foreign ore trade is likewise quiet, and there were no imports last week. Stocks lie at the docks.

Steel.

There is nothing fresh to report about the steel trade in the district, which remains quiet. In Cumberland there is little, if anything, being done, but the Barrow works have still their merchant, rail, hoop and small section mills partially employed. The Siemens and other foundries are also at work.

SHEFFIELD.

(*From our own Correspondent.*)

The Steel Trade.

IT is somewhat discouraging at present to write about the condition of the Sheffield steel trade. The cheerfulness which one was able to put into the reports up to a couple of months ago has practically all departed. Trade is still a long way better than it was before the revival last year end, but the improvement has not grown to the extent that was hoped, and latterly there has been a distinct falling off. The output of basic iron and steel is still large, especially in Lincolnshire and also in the Rotherham district. The extent of the production can be gauged from a statement made a few days ago by the managing director of Steel, Peech and Tozer, Limited, that in a recent week they turned out 11,200 tons of steel. He also mentioned that the firm had a billet mill which had ground out 120 tons of steel an hour, and in their bar mill they had produced 500 tons of steel in a complete working shift of twenty-four hours. The trouble is, however, that the demand is not keeping up. The orders that were placed some time ago are being rapidly worked off, but few are coming in to take their places. Prices have been reduced to such an extent that there is little or no profit in the trade, but without stimulating activity on the part of buyers. It is generally believed that the unsettled conditions on the Continent are largely responsible for the present sluggishness in trade, and a solution of the difficulty would be warmly welcomed.

The Lighter Branches.

The crucible steel trade shows little progress. The firms which are well placed for work are only a small minority, and taking the trade generally much slackness prevails. The continental buying of tool and other high grade steels has fallen away almost to nothing, while the engineering shops at home are making much less than their normal demands. In engineering, the electrical section is active, but other branches are in only a poor way. Agricultural implement makers are looking forward to an improved demand for machinery for next year, as the heavy crops of grain which are now being gathered may be expected to exhaust the supplies now existing.

Cutlery and Plate.

Cutlery is still quiet. Australia continues to be the best market overseas, and, with this exception, the export trade is on a very meagre scale. There has been a considerable falling off in the demand for stainless table knives. The pen and pocket knife departments are still very poorly employed, and feel the effects of severe German competition. There is little being done in the old-fashioned pattern razors, but a good demand exists for safety blades. Sheffield is now making wafer blades of excellent quality, which are sold at prices considerably less than those of American make. On the electro-plate side, the spoon and fork branch is busy, and continues to book large orders, but other sections are quiet. Negotiations are still proceeding with Russia with regard to large quantities of files, saws and engineers' small tools required in that country; but so far the inquiries have not been translated into actual business. The difficulty is one of finance. The local firms naturally demand cash down for their products, but the money is not forthcoming. Conflicting views are expressed as to the likelihood of a restoration of satisfactory economic conditions in Russia, and in the meantime Sheffield traders are pursuing a cautious policy.

Colliery Developments.

South Yorkshire enterprise with a view to increasing the fuel supplies of the country is well maintained. The latest reports of development relate to Barnburgh Main and Hickleton Main, two collieries in the Doncaster district. At the former, which at present works the Barnsley bed, operations for winning the Barnburgh deep seam have been resumed after a suspension of several years. The seam was found at a depth of 770 yards, and the management state that they hope to have it ready for working in from twelve to eighteen months. When it is fully developed, some five years hence, it will probably provide employment for about 2000 extra men. At Hickleton, also, the Barnsley seam is at present worked, and the colliery has an output of some 20,000 tons per week. It is intended to develop the Parkgate seam, and with a view to this the first shaft has been deepened and a new shaft has been sunk. The Parkgate lies at a depth of 814 yards. When it is fully opened out, a production of 10,000 tons per week, involving the employment of an additional 1000 men, is anticipated. The sinking operations revealed the existence of a new seam of coal at a depth of about 780 yards. It is a moderately good seam, and will probably be worked eventually.

Sheffield Gas and Water.

The Sheffield Gas Company has found itself able to make another reduction in its charges, which will now be the lowest of any industrial centre, if not in the whole country. One-fifth of a penny per therm, which is equivalent to 1d. per 1000ft., will be taken off the charge to small consumers, bringing the new rate down to 3s. 1d. per 1000ft. In the case of the larger consumers, the reduction is two-fifths of a penny per therm, and the cheapest price will now be 2s. 1d. per 1000ft. The Water Department of the Corporation is proceeding with the construction of its new reservoir in the Ewden Valley, and the work is expected to be completed in about five years. In anticipation of this expenditure, the department some years ago accumulated a fund of £147,000 in order to pay the interest on the capital expenditure during the period of construction, but increased costs, owing to the war, and decreased revenue caused by subsequent trade depression, compelled it to use this fund for ordinary purposes. The fund also enabled the department to defer the increase of charges to consumers, and such charges have yet only been raised to the extent of 65 per cent. In consequence of this expenditure, the Corporation has found it necessary to obtain parliamentary powers to capitalise the interest on the Ewden construction. For the past year it has capitalised £37,375, which would otherwise have had to be paid out of revenue, and the accounts, made up on this basis, show a surplus of £3402. The Water Committee is hoping to accumulate a substantial reserve during the next five years, as, when Ewden reservoir is completed, it will have to face an immediate addition to the expenditure, estimated at £112,000 a year.

Wireless Developments.

I have previously referred to the difficulty experienced by Sheffield wireless enthusiasts in obtaining satisfactory "listening-in" results owing to the long distance of the broadcasting stations from the city, and to the proposal to establish a relay station in Sheffield. Arrangements have now been entered into between the Union Grinding Wheel Company and the British Broadcasting Company for the provision of a site for the new station in Corporation-street. The new station will probably be opened within the next few weeks, by which time it is anticipated that the Post Office will have laid the necessary land line. The new facilities should result in a great increase of wireless activity in Sheffield, particularly as they are expected to make the use of cheap crystal sets much more feasible and convenient than is at present the case.

In the District.

There are one or two interesting items of news from places in the district. One comes from Goole, and is to the effect that the Aire and Calder Navigation is paying the freeholders and copyholders of the ancient parish of Hook £5000 for the abolition of the Hook landing, on the banks of the Ouse at Goole, with its rights, in order that they may prosecute a scheme of river improvements, which will include the extension of the Goole promenades. Also from Goole it is reported that the Urban Council has decided to dispose of the war tank which was awarded to the town for its efforts in regard to the sale of War Savings Certificates. The tank is to be sold as old iron, and tenders are being invited for its purchase, break-up, and removal. At Gainsborough, a Ministry of Health inquiry has been held with regard to the Council's application for power to borrow £5440 for the purchase of a new pumping plant for the artesian borings.

NORTH OF ENGLAND.

(*From our own Correspondent.*)

Outlook Growing Serious.

THE trade outlook in the North of England grows more and more serious, and there seems every likelihood that within the next few weeks there will be considerable additions to the number of unemployed in the area. Manufacturers of iron and steel are reducing their operations. This week Whitwell and Co., Limited, have damped down their two blast-furnaces, thus laying idle once more the whole of the Thornaby Ironworks. It was only about three months ago that these works were restarted after being idle nearly two years. Unfortunately the firm had "missed the tide." Already the brief boom in the iron trade which followed the occupation of the Ruhr by the French was ending, and unable to find a market for its output the company, which was recently reconstructed, has been reluctantly compelled to cease operations. Both the furnaces operating were producing hematite pig iron, and the stoppage reduces the number of furnaces now producing East Coast hematite to 13. This makes 7 blast-furnaces which have been put out of action since the end of June. The lack of export trade in iron and steel is causing serious disquiet. The depression in all the continental exchanges is a big handicap to British manufacturers, and for the moment renders export business very difficult if not impossible. Nor is the home market in any better condition. The works are all very slack, and consumption has so fallen off that even the greatly reduced output exceeds the demand.

Cleveland Iron Trade.

The position in the Cleveland pig iron trade is very discouraging, business having fallen to a very low ebb. There is a belief in some quarters that the market has touched bottom, but it seems hopeless to expect any improvement in the export trade until some measure of stability has been restored to the continental exchanges. Home business may revive after the holidays. Consumers have been buying from hand to mouth for months past, and although they may continue that policy, yet they are bound to cover urgent needs, and it is believed that it will soon become necessary to place a few orders to enable works to carry on. However, that is pure speculation. The facts are that at the moment there is practically no demand for iron, and it is difficult to find a market even for the restricted output. Values are steady, No. 1 Cleveland foundry iron being 110s.; No. 3 G.M.B., 102s. 6d.; No. 4 foundry, 97s. 6d.; and No. 4 forge, 96s.

Hematite Pig Iron.

The drastic curtailment of production in the East Coast hematite pig iron trade has arrested the downward trend in prices, but business is still very slow. Mixed numbers are quoted at 98s. 6d., both for home use and export.

Iron-making Materials.

Complete stagnation of business is reported in the foreign ore trade. Consumers still have large stocks and will not commit themselves further, although best Rubio is offered at 23s. per ton c.i.f. The export demand for coke is such that the closing down of a number of blast-furnaces has not materially relieved the stringency of supplies to the works, and the price of good medium furnace kinds keeps firm at 41s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

Quiet conditions still prevail in the manufactured iron and steel trade, but there is a little more inquiry, and although competition for orders is very keen, and is tending to depress prices, the outlook is regarded as a little brighter. Most of the works will be idle next week for the annual trade holidays. This week steel rails have been reduced by 10s. per ton to £9 10s., and soft steel billets have fallen a similar amount and now become £9.

The Coal Trade.

There is absolutely no improvement in the

Northern coal trade in any direction. Orders are almost entirely absent, while for any business offered there is very keen competition, resulting inevitably in undercutting the current quotations. There is at the moment an entire absence of anything like stability, so that when buyers come along they are able to enforce their own ideas, either direct with the colliery or at least with second-hand holders. As a rule, the collieries at the best are experiencing considerable difficulty in continuing to work regularly, while in some cases time at the pits is being lost, so that the tone of the market deteriorates consistently from day to day. Continental export trade is very slack, and exporters are passing through a very anxious time. They are severely hit by the slump in values, which was entirely unforeseen and is having disastrous consequences. Foreign currency depreciations and the difficulty in arranging adequate credits in sterling is, of course, an important factor in the scarcity of foreign orders, though there are no buyers of any quantities for home either. Northumberland steam coals are very slack and freely offered, both direct and in second hand, and secondary classes are also in plentiful supply at discounted rates. Small steams, however, are rather scarce and steady in the absence of business for screened sorts. Gas coals are slow of sale, while coking and bunkers are plentiful and obtainable at lower prices than seemed likely a very short time ago. The coke market for all classes of foundry and gas coke is nominally steady, with prices unaltered to any great extent.

SCOTLAND.

(From our own Correspondent.)

Dreary Conditions.

The industrial situation still leaves much to be desired, and the outlook shows no improvement. All markets indicate a measure of uncertainty, and profitable business is scarce. The position in the Rhur has had, and is still having, a greater adverse influence than was thought possible, and it, together with untoward happenings at home, has created a state of stagnation in many trades. Unemployment is still heavy.

Pig Iron Prices Falling.

The demand for pig iron is not improving and business all over is at a low ebb. Stocks, small as they are, cannot be easily disposed of at the quoted prices, and no great success has attended the offerings of lots at cheaper rates.

Steel and Iron Works Partially Engaged.

The lack of trade is reflected in the situation at the steel and ironworks, where only a percentage of the workers are employed. In practically all districts the plants are working far below capacity, and little change can be expected until the shipyard trouble is over. The reduction of 5s. per ton in steel prices may bring out a few orders eventually, but up to date the benefit is barely discernible. Export in steel shows a slight movement in the right direction. Inquiries, at least, are better. Almost all departments of the iron trade are similarly placed, and little relief is expected for a month or two at the earliest. Local makers are not only encountering keen competition from producers across the border, but are more than alive to the increased continental bookings of finished materials.

Reduction in Copper.

Manufactured copper has been reduced by £2 per ton, making the quotation £98 per ton basis for strong.

Coal Trade Uneven.

The coal market has been uneven and erratic. The prompt demand for large fuels has been a meagre one, despite the offering of cheaper prices, and collieries report accumulations of stocks. Forward inquiries are heavy enough, but holders are not disposed to contract far ahead, while prices remain around present levels. Consequently the turnover in round coal is of small bulk. Washed fuels are still busy, but the pressure for supplies has slackened somewhat, and prices are not so strong. Shipments are fully maintained. Old contracts are partly responsible for foreign clearances, while the coastwise traffic has been unusually heavy. Aggregate shipment amounted to 318,762 tons, against 305,285 tons in the preceding week and 381,111 tons in the same week last year. Business in bunker coals has been brisk. The home demand for fuel shows no expansion owing to the industrial situation and the time of the year. Economies are being effected on all sides. The usual autumn and winter contracts are being either held up until the last possible minute, while many are being substituted by as near as possible a "day to day" system of buying. Further reductions in prices of fuel of applicable to industrial consumers will no doubt bring an improvement in home demands.

Structural Steel Busy.

The steady demand and inquiry for structural steel is one bright spot in an otherwise gloomy situation. Some good contracts have been fixed of late, and there is promise of more to follow. Another feature, and one likely to prove very beneficial when trade shows a reviving tendency, is the reduction in railway rates.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

The steam coal trade has not yet fully recovered from the effect of the recent holidays, but there is evidence that the supplies are overtaking the demand, and unfortunately the inquiry from the Continent is more restricted than was the case before the vacation. The unsettled political and financial conditions prevailing on the Continent are crippling the demand, and it looks very much as if the position of the steam coal trade may not be anything like as satisfactory as was expected, notwithstanding the fact that so far as the collieries are concerned, they are well sold for the remainder of this month and the early part of next. It is just possible that some of the middlemen who hold quantities on contract may experience some difficulty in finding an outlet for their supplies at much above the price they paid for them. Already there is not the pressure for coals that was thought would be the case following the holidays. Quite a number of tips are reported to be idle at the various docks this week, and of course this is not a good sign. The Dutch railways are in the market for 20,000 tons of best steam coal, and tenders have gone in for the supply of 50,000 tons of Monmouthshire locomotive coals for delivery over six months, or 100,000 tons over twelve months from September 1st, to the Great Northern Railway Company of Ireland. Apart from these there are no inquiries of any importance, and unfortunately the general demand is meagre, while the financial conditions have had an adverse effect upon the shipment of coals to German ports.

Tin-plate Trade.

It is reported that an order for 20,000 tons of tin-plates, being the prelude to further orders, has been placed with a West Wales tin-plate company by the Nippon Oil Company of Japan. Considerable significance is attached to this order, which, if confirmed, means that the Welsh industry has regained the pre-eminent position in this market held for so long by the Americans.

Steel Trade Agreement.

The adjourned annual meeting of the Joint Board representing the South Wales Siemens Steel Association and the Iron and Steel Trades' Confederation, which was held last week, terminated very satisfactorily, inasmuch as agreement was reached on questions which were expected at one time to cause some difficulty. Among the claims advanced were that a joint committee be set up to consider the sliding scale with relation to the price of steel bars, with a view to a better adjustment; also that all adults under the sliding scale whose weekly wage at base rates is 30s. and under be given 1s. 6d. per shift advance, and those between 20s. and 30s. 6d. be given 1s. 5d. per shift advance. The men also asked for an annual holiday of a week with pay, that millmen be paid lost time for stoppages due to breakages, and that mills should finish at noon on Saturdays. The employers, whilst refusing to grant the lower paid men (labourers, &c.) the advances asked, agreed that men at present receiving 28s. 9d. (base rate) should in future receive 5s. per shift. If the full number of six shifts is worked this will mean 30s. per week. The employers also agreed to continue for a further period of three months the *ex gratia* payments now given above the sliding scale to all employees operating under the scale. The claim for a joint committee to consider the basis of the sliding scale, and for an annual holiday with pay were withdrawn, while a number of detail claims were referred to a joint committee for investigation.

Current Business.

The current demand for steam coals is far from active, and the conditions are becoming increasingly irregular. Although most of the leading collieries are well sold on paper and they are still very firm in their ideas for forward shipment, the market at the moment is on the easy side for prompt shipment. During the past week there have been a fair number of tipping appliances idle, and it looks very much as if before very long some of the collieries will be in need of prompt tonnage to lift coals, as otherwise they will be hard up for empty wagons. There is no doubt, despite the strong position of collieries so far as their sales are concerned, that best Admiralty large can be picked up for early shipment at roundabout 29s. 6d. to 30s., and second qualities at a shilling per ton less, but collieries will not sell at these figures ahead, more especially as there may quickly be a change in the governing conditions. The position in America and the negotiations proceeding regarding the trouble in their coalfield is being closely watched, though it is scarcely thought in some quarters that there will be a strike resulting in a big demand for coals from this country. The market here for anthracite coals is firm, and there is a good deal of loading pressure at Port Talbot and Swansea for these qualities.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Tin-plate Order.

It is now confirmed that South Wales tin-plate makers have secured the large order from a Japanese firm. This order, which will run into several hundred thousand boxes and is for delivery over September and October, is chiefly for the oil trade and will be split up between various makers of oil sizes.

Non-unionism.

Notices to terminate contracts in a fortnight's time were tendered on Wednesday by the miners in the Aberdare district on the non-unionist question. About 9000 miners are affected.

It is reported from Stockholm that the Swedish State Railways engineer, Mr. Erik Andersson, of Kristinehamn, has constructed a contrivance for the speedy unloading of timber from railway trucks which is said to effect a great saving of time and labour.

Australian Engineering Notes.

The House of Representatives, on July 25th, passed a Bill to extend the Northern Territory Railway southward to Daly Waters, at a cost of £1,500,000. A Bill was also introduced prolonging the Tariff Board for five years and providing for an additional member to represent the primary producers.

* * * * * *

The Melbourne Harbour Trust has purchased the Federal shipbuilding and dockyards at Williamstown (Melbourne) for £150,000. The yards were opened in 1913 as a State venture, and were purchased by the Federal Government during the war for £180,000. Six small cargo vessels for the Commonwealth Line of steamers were constructed at Williamstown. The present value of the dockyards is estimated at between £200,000 and £220,000. The Harbour Trust Commissioners intend to construct a new dry dock capable of accommodating the largest liners visiting the Commonwealth.

* * * * * *

The Randwick—Sydney—Municipal Council has accepted the offer of a syndicate to build an ocean pier at Coogee, a popular summer resort, at a cost of £156,000. The syndicate will be granted a lease for twenty-five years.

* * * * * *

It is reported that at the end of June there were 4000 men employed at the Broken Hill Proprietary's recently reopened steel works at Newcastle, and that the whole plant is being gradually put into commission again.

* * * * * *

An electrical scheme, to cost £1,000,000, is to be commenced next September by the New South Wales Railways Commissioners. The scheme provides for the creation of a hydro-electric power station at Marrangaroo, which it is hoped to have completed within two years. All the plant will have to be specially made in Great Britain. The station will provide current for railway purposes, and, in addition, towns on the mountains from Penrith to Lithgow and west as far as Dubbo will be supplied at 1d. per unit.

* * * * * *

A deputation recently waited upon the South Australian Premier and asked that tenders for the 20 high-power locomotives required by the Railways Department should be confined to Australia, on the ground that it would be impossible for local engineers or firms to compete with those in Great Britain on account of the lower scale of wages operating. Sir Henry Barwell replied that, while the Government was naturally anxious for the work to be done in the Commonwealth, he would point out that the engineering trade enjoyed a high tariff protection, and he did not think it would be contended that the Government had a duty to bolster up local industry regardless of anything else. Australia could not put up a ring fence and say she was going to carry on regardless of conditions anywhere else. His tendency would be to give the greatest margin of preference possible to Australian manufacturers.

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The value of the overseas trade of the Commonwealth for the year ending June 30th totalled approximately £250,000,000. Imports showed an increase of £29,000,000 and exports a decrease of £10,000,000.

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The Municipal Council at Temora (N.S.W.) is considering the advisability of erecting a 30,000-gallon concrete tank, 50ft. high, and the laying down of a 4in. pipe in the town.

* * * * * *

The Commonwealth Department of Works and Railways, Melbourne, is inviting tenders, closing October 17th, in connection with the purchase of a large quantity of floating and shore plant and equipment for the Henderson naval base near Fremantle.

* * * * * *

The River Murray Commissioner has approved of the construction of a weir and lock at a point about a mile down stream from Mildura. This work, which will be undertaken by the Victorian Government, will cost £230,000. The question of constructing another lock and weir in the vicinity of Wentworth is being considered.

Catalogues.

Boulton and Paul, Limited, Norwich.—Leaflet. Chaine-Helice liquid elevators.

Cochran and Co. (Annan), Limited, Annan, Scotland.—The Cochran book of Atlantic City.

British Pigirons, Limited, 2–6, Victoria-street, S.W. 1.—Pamphlet. "Pig irons of distinction."

T. Broadbent and Sons, Limited, Huddersfield.—Catalogue. Automatic centrifugal clutches.

J. W. Brooke and Co., Limited, Adrian Works, Lowestoft.—Leaflet. "Marine motoring made easy."

Drummond Brothers, Limited, Guildford.—Catalogue. The "Willing Worker" concrete mixer.

The Joseph Dixon Crucible Company, 22, Duke-street, Stamford-street, S.E. 1.—Booklet. The proper care of belts.

Dowson and Mason Gas Plant Company, Limited, Levenshulme, Manchester.—Catalogue. Dowson-Mason furnaces.

Service Motor Company, Limited, 94, Great Portland-street, W. 1.—The Gwynne Eight handbook, with oil chart.

Hathorn, Davey and Co., Limited, Leeds.—Catalogue. Horizontal three-throw plunger pumps for waterworks and mines.

Glenfield and Kennedy, Limited, Kilmarnock, Scotland.—Pamphlet. The Peebles patented sand washer for rapidly cleansing filter bed sand.

Consolidated Pneumatic Tool Company, Limited, Egyptian House, 170, Piccadilly, W. 1.—Supplement sheet, catalogue No. 42. Little Giant grinders and polishers. Accessories circular No. 86. India-rubber hose pipe and hose connections. Circular No. 87. Air compressors.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	26/-
(1) Spanish	24/-
(1) N. African	24/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	5 12 6	—
No. 1 Foundry	5 7 6	—
No. 3 Foundry	5 2 6	—
N.E. Coast—		
Hematite Mixed Nos.	4 18 0	4 18 0
No. 1	4 19 0	4 19 0
Cleveland—		
No. 1	5 10 0	5 10 0
Silicious Iron	5 7 6	5 7 6
No. 3 G.M.B.	5 2 6	5 2 6
No. 4 Foundry	4 17 6	4 17 6
No. 4 Forge	4 16 0	4 16 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge*	—	—
„ „ Foundry	5 0 0	—
(3) Northampton—		
Foundry No. 3	4 15 0	—
„ Forge	4 5 0	—
(3) Derbyshire—		
No. 3 Foundry	4 12 6 to 4 17 6	
Forge	4 5 0	
(3) Lincolnshire—		
Basic	5 5 0	—
Foundry	4 15 0	—
Forge	4 15 0	—
(4) N.W. Coast—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	5 15 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best „	—	—
N.E. Coast—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
Lancs.—		
Crown Bars	12 0 0	—
Second Quality Bars	11 5 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	12 10 0	—
Best „	13 10 0	—
Hoops	15 10 0	—
Midlands—		
Crown Bars	12 0 0 to 12 10 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	10 17 6 to 11 0 0	
Gas Tube Strip	12 10 0 to 12 15 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates, ¼in. and up	10 0 0	—
Sections	9 15 0	—
Steel Sheets, 3/16in. to ¼in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 17 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	10 0 0	—
Angles	9 10 0	—
Boiler Plates	14 0 0	—
Joists	9 15 0	—
Heavy Rails	9 10 0	—
Fish-plates	14 0 0	—
Channels	9 5 0	—
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 10 0†	—
Light „	11 0 0†	—
Billets	10 0 0†	—
Manchester—		
Bars (Round)	11 0 0 to 11 5 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	9 15 0 to 10 0 0	
„ (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 5 0	—
Hoops	12 15 0 to 13 5 0	
Soft Wire Rods	12 10 0	—
Midlands—		
Small Rolled Bars	9 15 0 to 10 0 0	
Billets and Sheet-bars	7 15 0 to 8 5 0	
Gas Tube Strip	10 10 0 to 11 0 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 10 0 to 19 0 0	
Angles	9 15 0	—
Joists	9 15 0	—
Tees	10 15 0	—
Bridge and Tank Plates	10 5 0 to 10 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/1½
Block Tin (cash)	183 0 0
„ (three months)	184 0 0
Copper (cash)	63 12 6
„ (three months)	64 10 0
Spanish Lead (cash)	24 0 0
„ (three months)	23 17 6
Spelter (cash)	31 15 0
„ (three months)	31 5 0
Manchester—	
Copper, Best Selected Ingots	68 0 0
„ Electrolytic	71 0 0
„ Strong Sheets	98 0 0
„ Loco. Tubes	0 1 1½
Brass Loco. Tubes	0 1 0
„ Condenser	0 1 2½
Lead, English	25 5 0
„ Foreign	24 0 0

FERRO ALLOYS.

(All prices now nominal.)

Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5½ per lb.	
	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	10/6
„ 6 p.c. to 8 p.c. „	£21 0 0	8/-
„ 8 p.c. to 10 p.c. „	£20 0 0	8/-
„ Specially Refined		
„ Max. 2 p.c. carbon	£50 0 0	18/-
„ „ 1 p.c. „	£60 0 0	21/-
„ „ 0.75 p.c. carbon	£70 0 0	22/6
„ carbon free	1/6 per lb.	
Metallic Chromium	4/6 per lb.	
Ferro Manganese (per ton)	£18 for home, £20 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 10 0 scale 5/- per unit	
„ „ 75 p.c.	£20 10 0 scale 6/- per unit	
„ Vanadium	16/9 per lb.	
„ Molybdenum	9/6 per lb.	
„ Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£130	
Cobalt	12/- per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

	Export.
SCOTLAND.	
Lanarkshire—	
(f.o.b. Glasgow)—Steam	19/-
„ „ Hill	20/3
„ „ Splint	20/- to 22/-
„ „ Trebles	25/-
„ „ Doubles	24/-
„ „ Singles	23/-
Ayrshire—	
(f.o.b. Ports)—Steam	19/-
„ „ Splint	20/-
„ „ Trebles	25/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	20/- to 22/6
Screened Navigation	29/-
Trebles	25/6
Doubles	24/6
Singles	23/6
Lothians—	
(f.o.b. Leith)—Best Steam	20/6
Secondary Steam	19/-
Trebles	25/6
Doubles	24/6
Singles	23/6
ENGLAND.	
(8) N.W. Coast—	
Steams	31/6
Household	46/6 to 57/6
Coke	48/-
Northumberland—	
Best Steams	22/6 to 23/6
Second Steams	20/6 to 22/-
Steam Smalls	15/6 to 17/-
Unscreened	20/6
Household	25/- to 28/-
Durham—	
Best Gas	24/6 to 25/6
Second	21/6 to 22/6
Household	25/- to 28/-
Foundry Coke	60/- to 62/6
Sheffield	Inland.
Best Hand-picked Branch	32/6 to 34/6 —
Barnsley Best Silkstone	26/6 to 28/- —
Derbyshire Best Brights	25/- to 27/- —
„ „ House	22/6 to 23/6 —
„ „ Large Nuts	20/- to 21/6 —
„ „ Small „	15/- to 16/- —
Yorkshire Hards	21/- to 23/- —
Derbyshire „	20/- to 22/- —
Rough Slacks	11/6 to 13/6 —
Nutty „	10/- to 12/- —
Smalls	7/- to 9/- —
Blast-furnace Coke (Inland)	35/- to 36/6
„ „ (Export) f.o.b.	44/- to 45/6
(9) SOUTH WALES.	
Cardiff—	
Steam Coals:	
Best Smokeless Large	29/6 to 30/6
Second „ „	28/- to 29/-
Best Dry Large	29/- to 30/-
Ordinary Dry Large	27/- to 29/-
Best Black Vein Large	28/6 to 29/6
Western Valley „	27/6 to 28/6
Best Eastern Valley Large	27/- to 28/-
Ordinary „ „	25/- to 27/-
Best Steam Smalls	20/- to 21/-
Ordinary „	18/- to 20/-
Washed Nuts	30/- to 32/6
No. 3 Rhondda Large	31/- to 32/-
„ „ Smalls	25/- to 26/-
No. 2 „ Large	23/- to 24/-
„ „ Through	18/6 to 20/6
„ „ Smalls	16/- to 17/-
Coke (export)	55/- to 60/-
Patent Fuel	32/- to 34/-
Pitwood (ex ship)	31/6 to 32/-
Swansea—	
Anthracite Coals:	
Best Big Vein Large	50/- to 52/6
Seconds	42/6 to 45/-
Red Vein	32/6 to 35/
Machine-made Cobbles	62/6 to 65/-
Nuts	62/6 to 65/-
Beans	45/- to 47/6
Peas	27/6
Breaker Duff	12/6 to 13/-
Rubbly Culm	15/- to 16/-
Steam Coals:	
Large	25/- to 26/-
Seconds	22/- to 24/-
Smalls	14/- to 16/-
Cargo Through	20/- to 22/6

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

* Quotations extremely high and nominal. † Latest quotations available.

French Engineering Notes.

(From our Correspondent in Paris.)

Iron and Steel Production.

The fact that the pig iron output should be rapidly approaching the normal at a time when there is so much difficulty in procuring adequate supplies of coke affords proof that the metallurgical industry has far more vitality than would seem to be justified by the amount of business done. As I have repeatedly pointed out there is no lack of business available whenever there appears likely to be some improvement in the situation generally, and if it were not for the cautious attitude of capital, all the works and factories would have plenty of orders in hand. Even now there is a good deal of activity in all kinds of constructive operations. Manufacturers know that the situation is sound, and they have consequently plenty of confidence in the future. The reconstruction of factories in the north continues to provide orders for steam boilers and machinery. In these circumstances there is no tendency to restrict the production of raw and semi-manufactured material, the more so because the depreciation of the franc is enabling steel makers to export increasing large quantities of blooms and billets. There is a certain feeling of regret that so much raw and semi-manufactured material should be sent abroad instead of being worked up into finished products, but it helps at least to pay for imported coal and coke, which have to be purchased in larger quantities to make up for the deficit from the Ruhr. The Belgian Government, indeed, is credited with having the intention of limiting or prohibiting the export of coal with a view of preventing an appreciation of values on the home market. The heavy fall in the value of the Belgian franc has had the effect of considerably increasing consignments of coal to this country, and a limitation of supplies would certainly tend to harden the prices of coal in France. There has been for some time past a steady strengthening of values which, it is firmly expected, will undergo a still further advance in the coming month. Now that the stocks of coal in the Ruhr appear to have been nearly exhausted, the failure of the French authorities, so far, to induce the Germans to work at the ovens is a possible factor of serious perturbation in the early future. Notwithstanding the uncertainty of the situation prices of iron and steel have not advanced to the extent that was feared at the time of the rapid rise after the Ruhr occupation.

What to do with Stocks.

It is stated that there are more than half a million tons of iron and steel products in the Ruhr, and that the French have already seized about 200,000 tons of rails, girders and merchant sections of all kinds. The method of disposing of these stocks without prejudicing the position of French manufacturers is being investigated by the Interministerial Commission appointed for the purpose. In a general way, it is proposed to deal with the Ruhr stocks in much the same manner as the stocks that were left over after the war. Representatives of those in the devastated regions who are entitled to reparations may form a group for the distribution of a certain quantity of the material, and it is possible that other groups may be constituted for the purpose, while the Minister of Colonies has announced that he will take 25,000 tons of rails and metal sleepers for the Trans-Saharian Railway, which implies either that the Sahara railway scheme is to enter upon a phase of practical realisation or that the material will be held in reserve for an indefinite period.

Refloating the France.

When a year ago the battleship France struck an unchartered rock in the Quiberon Bay and sank in a depth of water that left its side a few feet above the surface at low tide, all idea of refloating it for reconditioning was abandoned. The currents in the channel are extremely violent, and the difference between high and low water level is from 18ft. to 20ft. The Admiralty desired to recover the guns and other objects of military value. The only way of doing this was to refloat the battleship, which, however, could not be done by the usual means, such as were employed to refloat the Leonardo di Vinci. On account of the currents and the tides a compressed air plant and repair equipment to make the hull watertight could not be employed from a separate vessel, and it was only recently that the Admiralty accepted a tender from two Paris engineers, M. Alfred Pasquet and Colonel Henri Bons, to raise the battleship by a new patented method. On the hull of the battleship emerging from the surface at low tide will be fixed five vertical tubes, each 3 m. in diameter and 15 m. high. These five tubes will support a bridge 10 m. wide which will be fitted with the entire equipment necessary for the work, together with all stores, cranes, wireless, lifeboats, and lodgings for the engineers and men so that the work can be carried on continuously in all weathers. At the top of each tube will be an air lock to allow of the men descending into the hull. It is expected that the installation on the hull will be completed in about three months, and the contractors hope to refloat the France in from one year to eighteen months.

The Merchant Marine.

The latest returns of the number of merchant vessels laid up in French ports show a distinct improvement in the shipping trade, there being 409 vessels with a total tonnage of 661,382 tons on July 15th last, as compared with 450 ships with an aggregate of 796,284 tons on April 15th. The total for July included 14 passenger steamers, 166 cargo boats, and 108 sailing ships. During the three months there was a diminution of 14 per cent. in the number of vessels laid up and of 17 per cent. in the tonnage.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

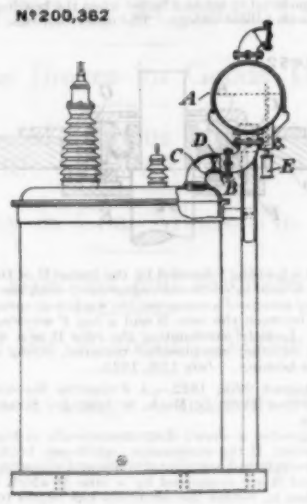
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TRANSFORMERS AND CONVERTERS.

200,362. July 12th, 1922.—Improvements in and relating to Casings for Liquid Cooled Electrical Apparatus, such as Transformers, The British Thomson-Houston Company, Limited, of Crown House, Aldwych, W.C. 2.

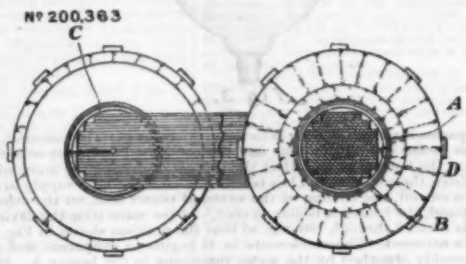
The general object of this invention is to compensate for expansion and contraction of the liquids used for immersing electrical apparatus. The drawing shows the invention applied to a transformer. A is an expansion chamber or conservator. At B there is a valve which normally practically closes the opening or passage-way through the pipe C, but there is a small hole D in the centre of the valve. As the liquid in the main casing of



the transformer expands and contracts it is permitted to flow to and from the expansion chamber, but the small hole D prevents convection currents. The liquid in contact with the air in the expansion chamber therefore remains cool at all times and is substantially free from the effects of oxidation. A breather E permits air to pass into and out of the expansion chamber as the level of the liquid alters. The occurrence of an accidental fault, such as a short circuit or arc, in the transformer may cause a large volume of air to be generated and creates pressure in the casing, but this is prevented by the valve D opening.—*July 12th*, 1923.

200,363. July 12th, 1922.—Improvements in and relating to Electrical Induction Apparatus, *The British Thomson-Houston Company, Limited, of Crown House, Aldwych, W.C. 2.*

The invention relates more particularly to electrical induction apparatus for insulating the windings of transformers from the core. The windings are insulated from the legs of the core by cylinders A composed of insulating material. The winding legs are built up of longitudinal lamination of several different widths, resulting in a number of longitudinal projecting edges or corners along their surfaces. These projecting edges or corners tend to distort the electrostatic field, each edge or corner tending to produce a concentration of electrostatic flux and consequent high dielectric stress in the adjacent portion of the insulation. It is desirable that the electrostatic field should be uniformly distributed so as not to subject any portion of the insulation within the field to more than the average value of electrostatic stress. To attain this result a cylinder B of elec-

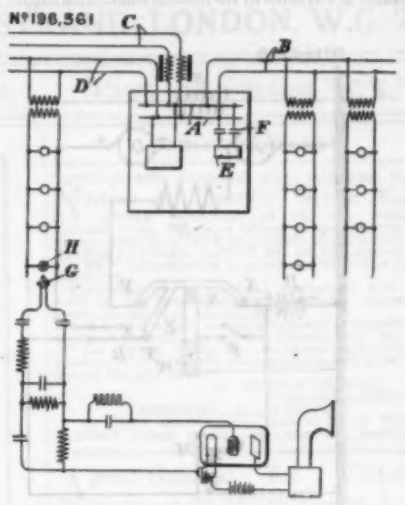


trically conductive material is interposed between each winding leg of the core and the corresponding insulating cylinder A. The conductive cylinders may be composed of any suitable material, such as wire gauze, thin sheet metal, tin foil, or metallic paint applied to the inner surfaces of the insulating cylinders A, but these conductive cylinders each have a longitudinal break or interruption to prevent short circuit currents and consequent heating. Insulating cylinders C between the conductive cylinders B and the surfaces of the winding legs of the core prevent contact of the conductive cylinders with the projecting corners of the winding legs and consequent heating by short circuiting of portions of the winding legs by the conductive cylinders. Electrical connections D between the conductive cylinders and the core maintain these cylinders and core always at the same potential in order to distribute the dielectric stresses within the insulating cylinders C.—*July 12th*, 1923.

TELEGRAPHS AND TELEPHONES.

196,561. July 25th, 1922.—Improvements in High-frequency Signalling Systems, *The British Thomson-Houston Company, Limited, Crown House, Aldwych, W.C. 2.*

The invention relates to high-frequency signalling systems in which modulated high-frequency waves are transmitted over existing power distribution systems. From the station bus-bars A current is supplied to the feeder circuits B, C and D. A signal transmitter is shown at E, and it is connected to the bus-bars through condensers F, which prevent the flow of current from the power system into the signal transmitting apparatus. A receiving apparatus for receiving the signals transmitted may be

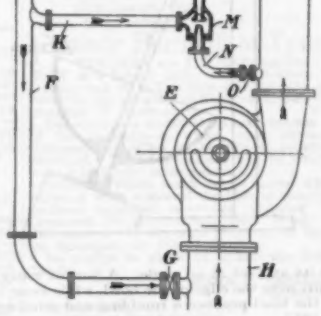


connected by means of a plug G to any socket H in place of a lamp or other current-consuming device, and the receiving circuit may include a filter circuit as shown in the lower part of the diagram. The system is intended for the broadcasting of news and music.—*July 12th*, 1923.

ELECTRICAL APPLIANCES.

200,149. March 10th, 1922.—Improvements relating to Ventilating or Cooling Electrical Machines, Karl Baumann, of Northwood House, Barnfield, Urmston, Lancashire, and The Metropolitan-Vickers Electrical Company, of 4, Central Buildings, Westminster.

This invention relates to cooling or ventilating electrical machines and in particular to arrangements in which air is caused to circulate in a closed circuit through the machine and is cooled at some point in the circuit by means of a water-cooled device similar in character to a steam condenser of the surface type. When the air circuit is not in an air-tight condition it is desirable to avoid the use of extremely cold water in the cooling device, and in order to avoid this, part of the circulating water which has been warmed by being passed through the cooler can be re-circulated through the device, or when the cooling water is supplied from the same circulation system as that of a steam



surface condenser, a part of the warmed water from the condenser may be caused to pass through the air cooler. In the particular system illustrated the air cooler A is included in a closed air circuit, which also includes the machine to be cooled. The water inlet port of each air cooler A is connected by a pipe B controlled by a valve C with the main circulating water inlet pipe D of a steam condenser at a point on the delivery side of the circulating pump E. The water discharge port of the pump is connected by a pipe F controlled by a valve G with the pipe H at a point on the suction side of the pump. A by-pass K controlled by a valve L is inserted between the inlet and outlet pipes B and F, the by-pass including an ejector M having a motive fluid connection N through a valve O with the pipe D at the delivery side of the pump.—*July 10th*, 1923.

MOTOR CARS AND ROAD TRAFFIC.

186,318. August 18th, 1922.—Improvements in Electric Lighting and Starting Machines for Motor Vehicles, Robert Bosch, Aktiengesellschaft, of 4, Militarstrasse, Stuttgart, Germany.

According to this invention a switching device is used to enable the individual windings of a starting and lighting machine as employed on motor vehicles to be connected either as a compound-wound motor or as a shunt dynamo. A is the armature coil with few conductors, D the other armature coil with numerous conductors, H the series field winding, and N the shunt field winding, B the accumulator, M the ordinary automatic battery switch, F the starting switch, and S the electromagnetic main switch. In order to start the engine the switch F, which is of the press-button type, is closed. The coil W of the main switch S is then excited so that the switch bridges over the contacts X and Y and with its arm Z opens the contact R and closes the contact T. Current then flows from the battery B

over X Y, the series field coil H, armature A and the earthed portion of the machine back to the battery. Also from the bridge of the switch S through T, the shunt field coil N and earth back to the battery. The machine then runs as a compound motor and provides an extremely powerful turning moment. When the internal combustion engine has started, the starting switch F is again opened, whereupon the main switch S returns to its inoperative position. The electrical machine is now operated as a dynamo by the internal combustion engine, and the

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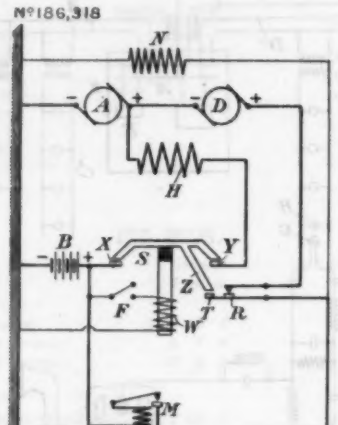

following paths are opened for the current :—From the positive brush of the low-current armature coil D over the contact R, which is now closed; the automatic battery switch M to the battery B over the earthed body of the car; and the heavy current armature coil A to the negative brush of the armature coil D. The shunt field coil N is branched off in front of the automatic switch M and is therefore connected between the negative brush of the armature A through earth and the positive brush of the armature D.—*July 12th*, 1923.

MACHINE TOOLS AND SHOP APPLIANCES.

200,350. June 30th, 1922.—Cleaning Swarf, J. A. Warburton, 17, Grafton-street, and J. E. Reid, Rothsay, Clifford-street, Gouldburn, New South Wales.

This apparatus is intended for separating metal turnings, &c., from the sweepings of workshop floors. It comprises a rotary

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bowl, with its axis set at an angle. A flow of water is used to wash the dirt over the edge of the bowl, while loose balls in the bottom of the bowl produce a rumbling and grinding action.—*July 12th*, 1923.

TRAMWAYS AND RAILWAYS.

200,377. July 19th, 1922.—Rail Joints, S. Butler, 47, Condorgrove, Blackpool.

A pair of substantially channel-shaped welding plates A and B are shaped to fit in the rail recesses and draw up flush with the web. The plates are each provided with upper and lower flanged edges E and F respectively, which provide an exposed surface or corner for welding to the rail, as shown at G. The upper flanges E of each plate are somewhat larger than the

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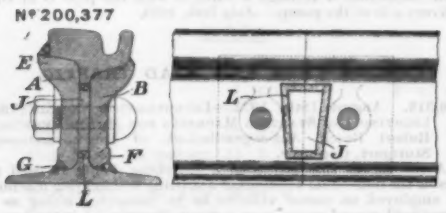

lower ones and extend beyond the width of the rail. For supporting and reinforcing the web of the rail, an insertion piece J is arranged in an opening in the web of the rail. The opening is of slightly larger size than the insertion or filling piece, so as to leave a space for the welding material L. The filling pieces may be separate from or formed in one with the welding plate.—*July 12th*, 1923.

MISCELLANEOUS.

194,653. March 7th, 1922.—Improvements relating to Unidirectional Electric Current-carrying Devices, *The Westinghouse Brake and Saxby Signal Company, of* 83, *York-road, King's Cross, N.* 1.

The uni-directional current-carrying device described in this specification consists of a metal electrode upon which there is a layer of a compound of the metal and arrangements for making intimate contact with the layer. The metal plate is shown at A

Nº194,653

and the compound at B. If the plate is composed of copper the coating of compound may consist of cuprous oxide. In use the device has a lower resistance when current passes from B to A than it has when it flows in the opposite direction. There are nine other illustrations.—*July 12th*, 1923.

200,452. April 20th, 1922.—Ball Bearings, The British Thomson-Houston Company, Limited, 83, Cannon-street, London, E.C. 4, and F. H. Clough, Hillcrest, Hillmorton, near Rugby.

This invention relates to ball bearings for high-speed spindles, in which the bearing is able to move laterally, in a direction perpendicular to its axis, to enable the spindle to take up a fresh position and so damp out oscillations at high speeds. The walls of the space around the outer ball race are provided with a resilient material to act as a buffer when the bearing has moved sideways to its fullest extent. The outer ball race B is loosely

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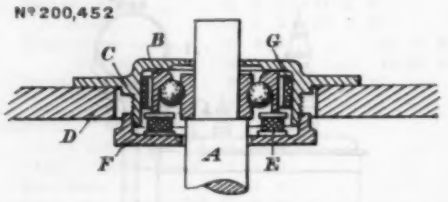

mounted in a housing C carried by the frame D of the machine. The race B is held in frictional engagement with the wall of the housing C by means of a compressible washer or spring E, which is clamped between the race B and a cap F screwed on to the housing C. Loosely surrounding the race B is a washer G of felt, rubber or other compressible material, fitting against the inside of the housing.—*July 12th*, 1923.

200,402. August 29th, 1922.—A Freezing Machine of the Absorption Type, L. Mach, 5, Aiblinger Strasse, Munich, Bavaria.

This refrigerator is shown diagrammatically in Figs. 1 and 2. A is the heater, B the evaporator, which are both formed as cylindrical vessels and are rotatable about a common axle. The vessels A and B are connected by a tube D which in the first position—that is, before the ammonia has begun to be driven out of the aqueous solution in A—lies as shown in Fig. 1. The tube D opens in the heater A above the level of the liquid, but in the vessel B at its lower part. If heat is conveyed to the heater A the ammonia is driven from the solution and the vapour

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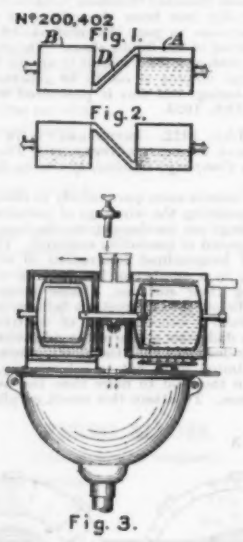

passes through the tube D to the evaporator B. The evaporator is cooled during this time and the condensed ammonia collects on the bottom of B. After the process of driving the ammonia from the solution in A has been completed the heat supply to A is cut off, the cooling of the vessel B ceases and, on the other hand, the heater A begins to cool. At the same time the device is rotated through 180 deg. so that the position shown in Fig. 2 is attained. The condensate in B begins to evaporate and is readily absorbed by the water remaining in the heater A. By the evaporation heat is withdrawn from the surroundings of the vessel B and ice is formed externally on its walls. A practical form of the apparatus is shown in Fig. 3.—*July 12th*, 1923.

CONTRACTS.

Belliss and Morcom, Limited, of Birmingham, have received an order for a 1500-kilowatt high-pressure steam turbine direct coupled to a Lancashire Dynamo and Motor Company's electric generator running at 3000 revolutions per minute, together with the surface condensing plant, which is also to be built by them, for the London, Midland and Scottish Railway Company's workshop electric power station at Derby.

The Societe Anonyme John Cockerill, of Seraing, Belgium, has received an order from the Staveley Coal and Iron Company, Limited, Barrow Hill, Chesterfield, for the supply of one twin tandem gas engine direct coupled to a 5000-kilowatt three-phase alternator, 6600 volts, 50 cycles, at 90 revolutions per minute. This engine will be operated by blast-furnace gas. The alternator will be supplied by the Ateliers de Constructions Electriques de Charleroi. The engine and two similar engines running in the Cockerill Company's own works in Belgium are the largest gas engines which have hitherto been built.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

SATURDAY, AUGUST 25TH.

Institution of Municipal and County Engineers.—North Wales District meeting at Prestatyn. 10.45 a.m.

FRIDAY, AUGUST 31ST, TO SATURDAY, SEPTEMBER 22ND.

Shipping and Engineering Exhibition at Olympia.

SATURDAY, SEPTEMBER 1ST.

Institution of Municipal and County Engineers.—South-Western District meeting to be held at Plymouth. 2.15 p.m.

SATURDAY TO SATURDAY, SEPTEMBER 1ST TO 8TH.

Institution of Naval Architects.—Summer Meeting in Holland.

MONDAY TO THURSDAY, SEPTEMBER 10TH TO 13TH.

Institute of Metals.—Autumn Meeting at Manchester.

WEDNESDAY TO WEDNESDAY, SEPTEMBER 12TH TO 19TH.

British Association.—Meeting at Liverpool.

MONDAY AND TUESDAY, SEPTEMBER 17TH AND 18TH.

Iron and Steel Institute.—Autumn meeting at Milan.

MONDAY, SEPTEMBER 17TH, TO WEDNESDAY, OCTOBER 3RD.

National Gas Exhibition at Bingley Hall, Birmingham.

EDUCATIONAL INTELLIGENCE.

A Goldsmid Scholarship, tenable in the Faculty of Engineering at University College, London, of the value of £120 (£40 a year for three years, subject to satisfactory progress), will be offered for competition at an examination to be held at the College in September. Particulars may be obtained on application to the Secretary of the College.

LAUNCHES AND TRIAL TRIPS.

Kilnsea, steamer; built by Irvine's Shipbuilding and Dry Docks Company, Limited, to the order of Wm. Brown Atkinson and Co., of Hull; dimensions, 389ft. by 51ft. 3in. by 27ft. 3in.; 8300 tons deadweight. Engines, triple-expansion, 26in., 42in. and 70in. by 48in.; constructed by Richardsons, Westgarth and Co., Limited; trial trip, August 2nd.

Tool and Cutter Grinding.—In a booklet recently issued by the Norton Company, of Worcester, Massachusetts, there is some good advice as to the best method of grinding milling cutters and such like tools on the grinding machines made by that company. The impression left after reading the booklet is that it is necessary to possess a "Norton 3846J vitrified" grinding wheel before starting work.

G.P.O. Engineers' Examination.—The Civil Service Commissioners announce that an open competitive examination for not fewer than twelve situations as Probationary Assistant Engineer in the Engineer-in-Chief's Department of the General Post Office will be held in London, commencing on November 6th next. Limits of age, twenty and twenty-five, with certain extensions. Regulations and form of application will be sent in response to requests by letter addressed to the Secretary, Civil Service Commission, Burlington-gardens, London, W. 1.

Grinding Thin Planing Knives.—We have received from Drabble and Sanderson, Limited, of Sheffield, an excellent little pamphlet on the grinding of the thin cutters used in wood planing machines. It is full of practical hints on the subject and emphasises some of the points unfamiliar to those not intimately associated with woodworking machinery. Thus, for instance, it is pointed out that the "jointer" used for trimming up the knives after they have been put in place should only be worked while the machine is actually cutting with a normal feed. Hints are given as to the best type of cutter steel for various classes of work.

Chair of Mining at Leeds University.—The University of Leeds has appointed Mr. J. A. S. Ritson, D.S.O., M.C., Professor of Mining in the University, in succession to Professor Granville Poole, who has been elected to a professorship at Armstrong College, Newcastle-on-Tyne. Mr. Ritson was educated at Uppingham and at Durham University (Armstrong College), where he graduated with distinction in mining and surveying, and has had considerable practical experience of colliery management in various parts of the country. He acted for some time as personal assistant to Sir William Walker, late Chief Inspector of Mines, and is at present Senior Inspector of Mines in the Cardiff district. He also holds the appointment of Testing Officer for approving rescue apparatus for use in mines, and in connection with this work he attended an international conference in the United States of America on the standardisation of mine rescue apparatus.

The Coopers Hill War Memorial Prize.—The Coopers Hill War Memorial Prize, which has been founded by members of the Royal Indian Engineering College, Coopers Hill, in commemoration of members of the College who fell during the war, is awarded annually by the Institution of Civil Engineers and triennially in turn by the Institution of Electrical Engineers, the School of Military Engineering, Chatham, and the School of Forestry, Oxford. The prize, which consists of (a) a bronze medal, (b) a parchment certificate of award, and (c) a money prize of the value of about £25, is awarded for the best paper on a professional subject selected by the Council making the award. One of the triennial awards falls this year to the Council of the Institution of Electrical Engineers, which has selected for the subject of competitive monographs "An Historical and Critical Survey of Atmospheric Electricity and Protection against Lightning." Papers submitted for the above purpose should reach the secretary of the Institution not later than December 31st, 1923. The I.E.E. award for 1923 is limited to corporate members of the Institution who were under thirty years of age on January 1st, 1923.